DOCUMENTS

OF THE

ASSEMBLY

OF THE

STATE OF NEW YORK

ONE HUNDRED AND THIRTY-SEVENTH SESSION

1914

VOL. XV.— No. 21 — PART 6

ALBANY
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1914

State of New York—Department of Agriculture

THIRTY-SECOND ANNUAL REPORT

OF THE

New York Agricultural Experiment Station

(GENEVA, ONTARIO COUNTY)

FOR THE YEAR 1913

With Reports of Director and Other Officers

TRANSMITTED TO THE LEGISLATURE JANUARY 15, 1914

ALBANY
J. B. LYON COMPANY, PRINTERS
1914

STATE OF NEW YORK

No. 21.

IN ASSEMBLY

JANUARY 15, 1914.

THIRTY-SECOND ANNUAL REPORT

OF THE

BOARD OF CONTROL OF THE NEW YORK AGRICULTURAL EXPERIMENT STATION.

STATE OF NEW YORK:

DEPARTMENT OF AGRICULTURE,

ALBANY, *January* 15, 1914.

To the Assembly of the State of New York:

I have the honor to submit herewith the Thirty-second Annual Report of the Director and Board of Control of the New York Agricultural Experiment Station at Geneva, N. Y., in pursuance of the provisions of the Agricultural Law.

I am, respectfully yours,

CALVIN J. HUSON,

Commissioner of Agriculture.

NEW YORK AGRICULTURAL EXPERIMENT STATION,

W. H. JORDAN, *Director.*

GENEVA, N. Y., *January* 12, 1914.

Hon. CALVIN J. HUSON, *Commissioner of Agriculture, Albany, N. Y.:*

DEAR SIR: I have the honor to transmit herewith the report of the Director of the New York Agricultural Experiment Station for the year 1913.

Yours respectfully,

BURT E. SMALLEY,

President Board of Control.

BOARD OF CONTROL.

Governor Martin H. Glynn, Albany.

Commissioner Calvin J. Huson, Albany.
Thomas B. Wilson, Hall.
Burt E. Smalley, Interlaken.
G. Hyde Clarke, Cooperstown.
Henry C. Harpending, Dundee.
Eugene M. Andrews, Union.
C. Willard Rice, Geneva.
Adrian Tuttle, Watkins.

OFFICERS OF THE BOARD.

Burt E. Smalley,
President.

William O'Hanlon,
Secretary and Treasurer.

STATION STAFF.

Whitman H. Jordan, Sc.D., LL.D., *Director.*

George W. Churchill,
Agriculturist and Superintendent of Labor.

William P. Wheeler,
First Assistant (Animal Industry).

[1] H. A. Harding, Ph.D.,
[2] Robert S. Breed, Ph.D.,
Bacteriologists.

Harold J. Conn, Ph.D.,
Associate Bacteriologist.

Godfrey L. A. Ruehle, M.S.,
James D. Brew, B.S.,
Assistant Bacteriologists.

Fred C. Stewart, M.S., *Botanist.*

Walter O. Gloyer, A.M.,
[3] Forest M. Blodgett, B.S.A.,
Associate Botanists.

Mancel T. Munn, B.S.,
Assistant Botanist.

Lucius L. Van Slyke, Ph.D., *Chemist.*

[4] Alfred W. Bosworth, A.M.,
Ernest L. Baker, B.S.,
Rudolph J. Anderson, B.S.,
Associate Chemists.

Arthur W. Clark, B.S.,
Morgan P. Sweeney, A.M.,
Otto McCreary, B.S.,
[5] Orrin B. Winter, B.S.,
[6] Alfred K. Burke, B.S.,
Assistant Chemists.

George A. Smith, *Dairy Expert.*

[7] Frank H. Hall, B.S.,
Vice-Director; Editor and Librarian.

Percival J. Parrott, M.A.,
Entomologist.

[8] William J. Schoene, M.S.,
[9] Fred Z. Hartzell, M.A.,
Associate Entomologists.

Harold E. Hodgkiss, B.S.,
Bentley B. Fulton, B.A.,
Assistant Entomologists.

Ulysses P. Hedrick, Sc.D.,
Horticulturist.

[10] Richard Wellington, M.S.,
[11] Roy D. Anthony, M.S.A.,
[12] Fred E. Gladwin, B.S.,
Associate Horticulturists.

George H. Howe, B.S.A.,
Charles B. Tubergen, B.S.,
Assistant Horticulturists.

Orrin M. Taylor,
Foreman in Horticulture.

Joseph F. Barker, M.S.,
In Charge of Soil Investigations.

Richard J. Keeler, A.B.,
Assistant Chemist (Soils).

Reginald C. Collison, M.S.,
Assistant Chemist (Soils and Horticulture).

[13] F. Atwood Sirrine, M.S.,
Special Agent.

Gertrude S. Mayo,
Director's Secretary.

Frank E. Newton,
Willard F. Patchin,
Lena G. Curtis,
Agnes E. Ryan,
Esther F. Hawkins,
Clerks and Stenographers.

Adin H. Horton,
Computer and Mailing Clerk.

Address all correspondence, not to individual members of the staff, but to the New York Agricultural Experiment Station, Geneva, N. Y.

The Bulletins published by the Station will be sent free to any farmer applying for them.

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[1] Resigned May 15.
[2] Appointed Aug. 1.
[3] Appointed June 18, in connection with Hop Culture Investigations; on leave after Oct. 18.
[4] Returned to duty Aug. 22 after absence on leave.
[5] Resigned Dec. 18.
[6] Appointed Feb. 17.
[7] Appointed Vice-Director May 20.
[8] Resigned Dec. 1.
[9] Connected with Grape Culture Investigations.
[10] Resigned Sept. 15.
[11] Appointed Sept. 1.
[12] Promoted from Special Agent Nov. 5; connected with Grape Culture Investigations.
[13] Riverhead, N. Y.

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Thirty-Second Annual Report

OF THE

Board of Control of the New York Agricultural Experiment Station.

TREASURER'S REPORT.

GENEVA, N. Y., *October* 1, 1913.

To the Board of Control of the New York Agricultural Experiment Station:

As Treasurer of the Board of Control, I respectfully submit the following report for the fiscal year ending September 30, 1913:

Maintenance Fund — Necessary Expense

APPROPRIATION 1912–1913

1912	*Receipts*	*Dr.*
Oct. 1.	To balance on hand	$1,019 37
	To amount received from Comptroller	24,000 00
		$25,019 37

Expenditures	*Cr.*
By building and repairs	$603 36
By chemical supplies	493 81
By contingent expenses	2,909 73
By feeding stuffs	1,263 12
By fertilizers	541 78
By freight and express	835 83
By furniture and fixtures	127 90
By heat, light and water	895 77
By library	1,105 73
By live stock	735 00
By postage and stationery	1,799 85
By publications	142 61
By scientific apparatus	1,234 39
By seeds, plants and sundry supplies	3,814 06
By tools, implements and machinery	466 58
By traveling expenses	3,045 59
By balance	5,004 26
	$25,019 37

GENERAL EXPENSE — HEAT, LIGHT, WATER, APPARATUS, REPAIRS, ETC.

1913	*Receipts*	*Dr.*
Oct. 1.	To balance on hand	$2 63
	To amount received from Comptroller	5,500 00
		$5,502 63

Expenditures	*Cr.*
By buildings and repairs	$2,630 39
By heat, light and water	2,732 12
By scientific apparatus	101 43
By tools, implements and machinery	27 40
By balance	11 29
	$5,502 63

Salaries

1913	*Receipts*	*Dr.*
Oct. 1.	To balance on hand	$5,154 75
	To amount received from Comptroller	52,000 00
		$57,154 75

	Expenditures	*Cr.*
	By salaries	$52,869 03
	Balance	4,285 72
		$57,154 75

Labor

1913	*Receipts*	*Dr.*
Oct. 1.	To balance on hand	$40 43
	To amount received from Comptroller	15,800 00
		$15,840 43

	Expenditures	*Cr.*
	By labor	$15,013 45
	Balance	826 98
		$15,840 43

Concentrated Feeding Stuffs Inspection

1913	*Receipts*	*Dr.*
Oct. 1.	To balance on hand	$218 05
	To amount received from Comptroller	4,500 00
		$4,718 05

Expenditures	*Cr.*
By chemical supplies	$54 95
By contingent expenses	1 00
By freight and express	38 12
By heat, light and water	256 90
By postage and stationery	25
By salaries	2,444 05
By scientific apparatus	80 42
By traveling expenses	70 48
Balance	1,771 88
	$4,718 05

FERTILIZER INSPECTION

1913	*Receipts*	*Dr.*
Oct. 1.	To balance on hand	$468 66
	To amount received from Comptroller	11,000 00
		$11,468 66

Expenditures	*Cr.*
By chemical supplies	$283 33
By freight and express	115 95
By heat, light and water	137 90
By labor	449 02
By postage and stationery	183 02
By salaries	5,960 59
By scientific apparatus	210 92
By seeds, plants and sundry supplies	7 34
By traveling expenses	24 05
Balance	4,096 54
	$11,468 66

FERTILIZERS, FEEDING STUFFS, ETC.

1913	*Receipts*	*Dr.*
Oct. 1.	To amount received from Comptroller.......	$357 63

	Expenditures	*Cr.*
	By freight and express....................	$14 47
	By labor..................................	91 99
	By salaries...............................	251 17
		$357 63

INVESTIGATION OF GRAPES

1913	*Receipts*	*Dr.*
Oct. 1.	To amount received from Comptroller......	$6,946 97

	Expenditures	*Cr.*
	By contingent expenses....................	$260 55
	By fertilizers............................	154 91
	By freight and express....................	34 19
	By furniture and fixtures.................	2 50
	By heat, light and water..................	3 20
	By labor..................................	1,088 57
	By postage and stationery.................	17 96
	By salaries...............................	4,965 89
	By scientific apparatus...................	44 07
	By seeds, plants and sundry supplies.........	153 24
	By tools, implements and machinery.........	7 31
	By traveling expenses.....................	214 58
		$6,946 97

INVESTIGATION OF HOPS

1913	*Receipts*	*Dr.*
Oct. 1.	To amount received from Comptroller.......	$1,015 88

Expenditures	*Cr.*
By contingent expenses	$500 25
By freight and express	1 08
By salaries	366 00
By scientific apparatus	81 62
By tools, implements and machinery	50 00
By traveling expenses	16 93
	$1,015 88

REPAIRS TO CHEMICAL LABORATORY

1913	*Receipts*	*Dr.*
Oct. 1.	To amount received from Comptroller	$4,708 92

Expenditures	*Cr.*
By repairs	$4,708 92

NEW BUILDINGS

1913	*Receipts*	*Dr.*
Oct. 1.	To amount received from Comptroller	$2,488 59

Expenditures	*Cr.*
By construction	$2,248 00
By equipment	240 59
	$2,488 59

SPECIAL FUND — HORTICULTURAL INVESTIGATION

1912	*Receipts*	*Dr.*
Oct. 1.	To balance on hand	$18 27

1913	*Expenditures*	*Cr.*
	By check to Treasurer of State of New York.	$18 27

Insurance Money

1912	*Receipts*	*Dr.*
Oct. 1.	To balance on hand	$22 07

Expenditures	*Cr.*
By check to Treasurer of State of New York	$22 07

United States Appropriations — Hatch Fund

Receipts 1912–1913	*Dr.*
To receipts from the Treasurer of the United States as per appropriation for fiscal year ended June 30, 1913, as per act of Congress, approved March 2, 1887	$1,500 00

Expenditures	*Cr.*
By labor	$1,500 00

Adams Fund

Receipts 1912–1913	*Dr.*
To receipts from the Treasurer of the United States as per appropriation for fiscal year ended June 30, 1913, as per act of Congress, approved March 2, 1887	$1,500 00

Expenditures	*Cr.*
By salaries	$1,471 20
By scientific apparatus	28 80
	$1,500 00

All expenditures are supported by vouchers approved by the Auditing Committee of the Board of Control and forwarded to the Comptroller of the State of New York.

WILLIAM O'HANLON,
Treasurer.

DIRECTOR'S REPORT FOR 1913.*

To the Honorable Board of Control of the New York Agricultural Experiment Station:

Gentlemen.— In accordance with statutory requirements, I have the honor to submit to you herewith the report of this institution for the calendar year 1913. It is gratifying to state that the year has been one of prosperity in the affairs of the Station in that the usual amount of work has been brought to a successful issue and the personal welfare of all connected with the institution has been maintained to a very satisfactory degree.

Through the kindness and consideration of your board, it was my privilege to spend several months in European countries, during which time I had the honor and privilege of visiting a good number of the best of the European experiment stations where I had the opportunity of informing myself concerning the policies and methods pursued by experiment stations whose existence was an inspiration and an aid in establishing similar institutions in this country. During my absence, Mr. Frank H. Hall, Vice-Director, administered the affairs of the Station, and I wish to gratefully acknowledge the loyal and efficient manner in which he attended to the duties of the position.

I shall briefly set forth the administrative and financial status of the Station, together with a brief summary of some of the more important work which we have accomplished during the year.

ADMINISTRATION.

STATION STAFF.

During the past year, the staff of this Station has been freely drawn upon to fill positions in other institutions.

Dr. Harry A. Harding, Bacteriologist, was called to a very impor-

* Reprint of Bulletin No. 372, December, 1913.

tant position in the University of Illinois. It was deemed highly desirable to retain the efficient services of Dr. Harding, but the inducements offered him at the institution where he is now located were such that it was not possible to offer an equally satisfactory arrangement. Dr. Harding had been connected with this institution since January 1, 1899, and during his period of service he not only built up an efficient department, but his work has been highly useful within the State and has attracted general attention throughout the country.

Mr. Richard Wellington, Associate Horticulturist, accepted a position in connection with the University of Minnesota. Mr. Wellington, through a residence at Harvard University for advanced study, and through habits of close application to the prosecution of his work here had reached a point where he was rendering efficient service in the department of horticulture.

Mr. William J. Schoene, Associate Entomologist, is now connected with the Virginia Polytechnic Institute, and holds the position of State Entomologist of Virginia. He had been connected with the entomological department of this Station since July 7, 1906. The work of Mr. Schoene had, at all times, been satisfactory and the Station meets with a distinct loss in his withdrawal from the institution. With the certainty that he will give to his new position the same ability and industry that he has shown here, assurance is given of his continued success.

While it is a distinct disadvantage to lose men who have established themselves in the work of the Station, it must be expected that, when called to positions of responsibility and greater financial advantage, the associates and assistants in the Station will occasionally be drawn away.

The Station has been very fortunate in being able to fill, in a very satisfactory way, the positions thus vacated.

Robert S. Breed, Ph.D., was called to the position vacated by Dr. Harding. Dr. Breed graduated from Amherst College in 1898 and later he was granted the degree of Doctor of Philosophy by Harvard University in recognition of advanced studies in biology. He has had the advantage of association with some of the leading workers in this country and in Europe in carrying on bacteriological researches, particularly along milk sanitation lines, and he comes

to the institution most efficiently equipped for the work which he will undertake. At the time Dr. Breed accepted the call to the Station, he was occupying the position of Professor of Biology at Allegheny College, Meadville, Pennsylvania, which position he had held for eleven years.

Mr. Roy D. Anthony, A.B., M.S.A., who accepted the position of Associate Horticulturist, entered upon his duties August 1, 1913. Mr. Anthony graduated from Rochester University in 1908. He afterwards entered Cornell University in order to pursue a course in horticulture, with special reference to pomology, and graduated from the latter institution in 1910. Previous to coming to this institution, he occupied the position of instructor in pomology in the State College of Agriculture.

Hugh Glasgow, Ph.D., of the University of Illinois, who is appointed to fill the position vacated by W. J. Schoene, will not enter upon his duties until January 1, 1914. Dr. Glasgow is a graduate of the College of Science in the University of Illinois, receiving the degree of Bachelor of Arts in 1908. Since that time, he has pursued advanced studies, particularly along zoological lines, at the University of Illinois, and in June of 1913, he was granted the degree of Doctor of Philosophy. He acted as student assistant in the Department of Entomology at the University for two years and, at the time of his appointment, held the rank of instructor in that department. He specialized particularly during his undergraduate and graduate work in the economic phases of entomology. At the same time, he gave considerable attention to bacteriology, plant pathology, protozoology and human parasitology. Such an educational equipment is a prophecy of excellent work in the field which Dr. Glasgow is now to occupy.

These appointments to the staff of the. Station, as has been the case so far as possible in all previous appointments, have been made with reference to building up a strong corps of men well equipped for the study of the problems important to agriculture. I am able to speak with great gratification of the excellent spirit which pervades the entire staff in relation to its work and of the hearty co-operation with which the members of the staff join in the study of problems where cooperation is essential.

MAINTENANCE FUNDS.

The legislative appropriations for the maintenance of the Station during the fiscal year ending September 30, 1913, were as follows:

Salaries	$52,000
Labor	15,800
Maintenance of general expenses of Station departments	24,000
Special grape work in Chautauqua county	7,500
General expense, heat, light, water, repairs, etc	5,500
Total	$105,800

Fertilizer inspection	$11,000
Feeding stuffs inspection	4,500
Total	$15,500

Appropriations by the Legislature for the current fiscal year are as follows:

Salaries	$52,000
Labor	16,000
For meeting the general expense of the Station departments	24,000
General expenses including heat, light, water, repairs, etc	5,500
For special grape investigations	7,500
For field, orchard and sanitary milk investigations	15,500
For special investigation in hop culture	5,000
Total	$125,500

For the analyses of samples of fertilizers, feeding stuffs, fungicides, insecticides and agricultural seeds submitted by the State Commissioner of Agriculture, and for the examination of Babcock glassware	$16,000

The appropriations which your Board has requested from the Legislature for the fiscal year beginning October 1, 1914, are as follows:

Salaries for scientific staff	$52,000
Labor	16,000
Necessary expenses of Station departments	24,000
General expense including heat, light and water	5,500
Investigations in grape culture	7,500
For field, orchard, truck, garden crops and sanitary milk investigations	15,500
Repairs, Dairy and Biological Building and forcing houses	1,500
Total	$122,000

For the analyses of samples of fertilizers, feeding stuffs, fungicides, insecticides and agricultural seeds submitted by the State Commissioner of Agriculture, and for the examination of Babcock glassware	$16,000

PUBLICATIONS.

During the past year, the Station issued 15 regular bulletins, 5 technical bulletins and six circulars. Eleven popular bulletins were also printed, presenting in a simpler form the data and conclusions of 11 of the regular, or so-called complete bulletins. The following table shows the distribution of these publications among the various departments of the institution. It should be stated that one of the bulletins classified under the Bacteriological Department, which relates to the effect of certain dairy operations upon the germ content of milk was the result of cooperative work between the Bacteriological Department and the Dairy Department.

	Bacteriology	*Botany*	*Chemistry*	*Entomology*	*Horticulture*	*Inspection*
Complete bulletins.	2	3	2	3	2	3
Technical bulletins.	2	....	1	2	....	....
Circulars	....	....	....	4	2	....

As is well known, the complete bulletins are only issued to a limited list, excepting that the bulletins giving the results of our inspection work are mailed to our full list of names. The popular bulletins are the ones that are more generally distributed to the people of the State. The following is a statement of the number of names now on our mailing list:

POPULAR BULLETINS.

Residents of New York	38,212
Residents of other States	2,267
Newspapers	760
Experiment stations and their staffs	1,800
Miscellaneous	100
Total	43,139

COMPLETE BULLETINS.

Experiment stations and their staffs	1,800
Libraries, scientists, etc	315
Foreign list	335
Individuals	3,501
Miscellaneous	100
Total	6,051

The Horticultural Department of the Station is continuing the work of preparing fruit monographs; the three that have been issued are in demand not only in New York but throughout the

entire country. The next volume to be issued will be entitled the "Cherries of New York." This will probably not be out of the press for at least two years. If circumstances permit, this volume will be followed by the "Peaches of New York;" the date of publication of which is at present quite uncertain.

It should be understood by the public at large that the demand for the "Apples of New York" was so great that the Legislature of 1913 authorized the printing of another edition of 5,000 copies, these copies to be sold at the cost of printing, which will probably be not far from $2.25 per set. This arrangement will enable those interested in apples to secure this publication whether residents of the State or not. Application for these should be made to the Commissioner of Agriculture at Albany, not to the Station.

INSPECTION WORK PERFORMED IN COOPERATION WITH THE STATE DEPARTMENT OF AGRICULTURE.

As is well known, the samples of fertilizers, feeding stuffs, fungicides and insecticides and seeds, collected by the Commissioner of Agriculture in the performance of his duties, are forwarded to this institution for analysis. The Station is also required by law to test the accuracy of, and brand, the Babcock glassware that is used in the State in those creameries and cheese factories where milk is purchased on the basis of the fat which it contains.

The following is a statement of the samples examined by the Station during the year that has now ended. We have also examined many samples of agricultural seeds, sent in by farmers, that were not official.

Fertilizers	931 samples
Feeding stuffs	737 samples
Agricultural seeds, official	293 samples
Agricultural seeds, non-official	955 samples
Total	2,916 samples

Milk bottles	17,692
Skim-milk bottles	209
Cream bottles	5,600
Acid measures	646
Pipettes	4,084
Total	28,231

Until the present fiscal year, the Station has carried the seed work and the examination of Babcock glassware without any appropriations for that purpose by the State and has used funds for this work which were not intended to be applied in these directions. The Legislature of 1913 made appropriations covering all inspection work.

INVESTIGATIONS RELATIVE TO HOP CULTURE.

The Legislature of 1913 appropriated $5,000 for conducting investigations in hop culture. Work in this direction was established at Hartwick, Otsego county. During the past season, attention was given only to the control of the mildew so seriously affecting the hop plant, and the results reached by the use of sulphur are very encouraging, as it appeared that a fair control of the disease was accomplished. It is proposed to enlarge this work by including problems relative to culture and the use of fertilizers. It may be possible to take up questions relative to the breeding of the plant.

INVESTIGATIONS RELATIVE TO GRAPE CULTURE.

For several years there has been located in Chautauqua county what is known as the Fredonia Grape Laboratory, the purpose of which has been to study various problems affecting the production of grapes. These problems have included chiefly the maintenance of fertility and the suppression of fungus and insect pests which prey upon the grape vine. There will soon be published a bulletin giving the outcome of the experiments with fertilizers, in which will be detailed results that are very encouraging to the grape-grower. Reasonable success has been reached in the control of the fungus and insect pests, and bulletins discussing several of these have been issued. There seems to be no doubt that the work, so far, gives promise of repaying many times the cost of the investigations.

It is now proposed to extend this type of work to the Keuka Lake region. A lease has already been effected of about twenty-two acres of grape land, mostly covered with bearing vines, around which will center the proposed inquiries. Problems in this latter district are somewhat different from those in the Chautauqua district. The work undertaken will have reference to these differences.

INVESTIGATIONS RELATIVE TO TOBACCO CULTURE.

For several years fertilizer experiments with the tobacco plant have been carried on at Big Flats and also at Baldwinsville. In the latter place, the work has been somewhat broader than the use of fertilizers and has included questions related to the rotation of crops. These experiments are being carried on in cooperation with the United States Department of Agriculture. Mr. George W. Harris has been the representative of the department, and upon him has fallen the duty of giving immediate supervision to the work. It has not seemed justifiable to publish results up to the present time, chiefly because this sort of experimental effort must be continued for some time before safe conclusions may be made.

SOIL INVESTIGATIONS.

Work in the study of soils and their needs is a comparatively new effort of the Station. This work is largely carried on on land outside of the Station farm although considerable areas are being applied to this kind of investigation on the Station property. At the present time, experimental work is being carried on in thirteen localities, involving in each place from two to eight acres of land. The total amount of land under experimental control in these thirteen localities is fifty-five and a half acres. The character of this work is described elsewhere.

INVESTIGATIONS IN THE INTERESTS OF VEGETABLE GROWING.

At the last meeting of your Board, it was decided to add to the activities of the Horticultural Department of the Station a new line of effort, namely, investigations in the interests of vegetable-growing and truck gardeners. In order to accomplish this work, authority was given to appoint an additional assistant horticulturist to enter upon that work. This matter is now receiving consideration and it is expected an appointment will be made in the near future.

EXPERIMENTAL WORK CONDUCTED OUTSIDE OF THE STATION LABORATORIES AND GROUNDS.

It is not possible for the Station to give attention to the numerous problems that are presented to it if it confines its work to the labora-

tories and grounds of the institution. As a rule, it is necessary to go where the particular problem exists in order to study it. For illustration, the problems related to grape culture must be studied in a grape-growing district, and the same is true of hops, tobacco and other special crops.

During the season of 1913, the Experiment Station conducted experimental work relative to twenty-five different problems in sixty townships and on 101 farms. These experimental efforts varied in size from work covering ten or more acres as in the case of the Auchter orchard and the experimental vineyard in Fredonia, which are extended over a period of not less than ten years, to experiments, on several areas, of a temporary character such as spraying an orchard for testing the efficacy of a particular spraying liquid. This work is not done primarily for educational purposes, but, in each case, the purpose was to acquire information. Nevertheless, these experiments have educational value to any farmers and fruit-growers who take the trouble to observe the results reached and, in this way, an experimental area may serve a most useful purpose to all of the fruit-growers or other producers in the district surrounding the farm where the experiment is located. The first consideration, however, is not to teach that which is known, but to get a larger vision concerning that which is not known.

There follows a list of subjects investigated, together with the name of the cooperator and the location of the experiment. The Station wishes to express its obligations to the various persons who have so kindly and efficiently cooperated with it in these various efforts. A discussion of some of the results reached in connection with these experiments will be found under another heading.

COOPERATIVE EXPERIMENTS CONDUCTED IN 1913.

BOTANICAL DEPARTMENT.

Nature of activity.	*Cooperator.*	*Location.*
Potato spraying experiments	H. F. Keyes	Rush.
Cause of poor potato stands	F. A. Sirrine	Riverhead.
Spraying currants for the control of cane blight and anthracnose	J. R. Clarke & Son	Milton.
Dusting hops with sulphur for the control of powdery mildew	W. P. King and F. X. King.	Hartwick.

ENTOMOLOGICAL DEPARTMENT: FIELD WORK WITH INJURIOUS INSECTS.

Nature of activity.	*Cooperator.*	*Location.*
Control of grape insects	James Barnes	Prospect Station.
Control of grape insects	Louis Bourne	Westfield.
Control of grape insects	H. L. Cumming	Fredonia.
Control of grape insects	Charles Horton	Silver Creek.
Control of grape insects	S. J. Lowell	Fredonia.
Control of grape insects	M. J. Sackett (2 lines)	West Irving.
Control of grape insects	Chas. Secord	West Irving.
Control of Hessian fly	H. F. Dabol	Clyde.
Control of Hessian fly	Experiment Station	Geneva.
Control of Hessian fly	G. E. Wolcott	Corning.
Control of cranberry toad bug	Cranberry Growers' Ass'n.	Riverhead.
Control of pear thrips	Ashley & Rockefeller	Germantown.
Control of pear thrips	C. E. Hover	Germantown.
Control of pear thrips	A. W. Hover & Bro	Germantown.
Control of pear thrips	Clarence Snyder	N. Germantown.
Control of pear thrips	Spencer Bros	Hudson.
Cabbage maggot experiments	Henry Cook	Geneva.
Cabbage maggot experiments	Geo. Gasper	Geneva.
Cabbage maggot experiments	Wm. Baker, Jr	Geneva.
Cabbage aphis experiment	Alfred G. Lewis	Geneva.
Cabbage aphis experiment	T. D. Whitney	Stanley.
Cabbage aphis experiment	Thompson Scoon	Geneva.
Cabbage aphis experiment	Newton Black	Stanley.
Experiments with apple aphides	William Smith	Albion.
Experiments with apple aphides	John Beckwith	New Haven.
Experiments with apple aphides	Geo. Simpson	Carlton.
Experiments with apple aphides	Harris Freeman	Albion.
Experiments with apple aphides	Albert Wood Est	Carlton.
Experiments with apple aphides	Thos. Mack	Holley.
Experiments with apple aphides	Geo. Smith	Lyndonville.
Experiments with apple aphides	J. Bayne	Lyndonville.
Experiments with apple aphides	A. J. Skinner	Knowlesville.
Experiments with apple aphides	E. J. Kelly	N. Rose.

ENTOMOLOGICAL DEPARTMENT: DEMONSTRATION EXPERIMENTS ON PEAR PSYLLA.

Cooperator.	*Location.*
E. E. Barnum	Albion.
Frank Gibson	Albion.
F. E. Hanlon	Medina.
Collamer Bros	Hilton.
W. W. Williams	Hilton.
H. E. Wellman	Kendall.
Ben. Wilson	Waterport.
Frank S. Hayden	Wyoming.
Geo. M. Rollfs	Albion.
Lyman M. Burrows	Albion.
Frank Bacon	Albion.
F. P. Hazelton	Le Roy.
S. S. Hopkins	Youngstown.
H. E. Horn	Albion.

ENTOMOLOGICAL DEPARTMENT: DEMONSTRATION EXPERIMENTS ON PEAR PSYLLA—*continued.*

Cooperator.	*Location.*
F. B. Howell	Medina.
S. W. McCollum	Lockport.
E. Moody & Sons	Lockport.
C. G. & R. L. Oaks	North Rose.
A. C. Pease	Oswego.
Ira Pease	Oswego.
R. L. Rogers	Albion.
David Smith	Middleport.
Delos Tenny	Hilton.
F. M. Tenny	Hilton.
Albert Wood Estate	Carlton.
F. M. Woolworth	Youngstown.
Lawrence Wright	Hilton.
Jay Allis	Medina.
Frank Bacon	Albion.
Spencer Brownell	Oswego.
John Cramer	Middleport.
Frank Curtis	Hilton.
C. E. Ernest	Gasport.
Harris Freeman	Albion.

HORTICULTURAL DEPARTMENT.

Nature of activity.	*Cooperator.*	*Location.*
Sod mulch *vs.* tillage	W. D. Auchter	Elmgrove.
Sod mulch *vs.* tillage	G. Hitchings	South Onondaga.
Stocks for apples	F. E. Dawley	Fayetteville.
Stocks for apples	E. Van Alstyne	Kinderhook.
Stocks for apples	A. Wood	Carlton.
Experiments with grapes:		
Fertilizer, cultural and pruning	H. Benjamin	Fredonia.
Cover crops and fertilizers	C. M. Hamilton	Ripley.
Cover crops and fertilizers	S. S. Grandin	Westfield.
Cover crops and fertilizers	Miss Frances Jennings	Silver Creek.
Cover crops and fertilizers	H. G. Miner	W. Sheridan.

DEPARTMENT OF SOILS.

Nature of activity.	*Size of field.*	*Cooperator.*	*Location.*
Fertilizers and cover crops in pear orchard	4 acres	L. L. Morrell	Kinderhook.
Cultivation and cover crop in pear orchard	3 acres	Lawrence Howard	Kinderhook.
Fertilizers, cultivation and cover crop in peach orchard	3½ acres	T. H. King	Trumansburg.
Fertilizers, cultivation and cover crop in apple orchard	8 acres	Great Bear Springs Co.	Fulton.
Fertilizers and cultivation and cover crop in cherry orchard	3 acres	P. F. O'Neil	Geneva.
Fertilizers and cultivation in apple nursery	2 acres	Theo. Smith	Geneva.
Fertilizers, cultivation and cover crops in apple orchard	8 acres	R. B. Densmore	Albion.

DEPARTMENT OF SOILS—*continued.*

Nature of activity.	*Size of field.*	*Cooperator.*	*Location.*
Fertilizers and deep plowing in vineyard	4 acres	F. E. Stone	Fredonia.
Fertilizers, deep plowing and tile drainage in vineyard	6 acres	D. W. Blood	Dunkirk.
Methods of growing alfalfa on Volusia soils	4 acres	W. P. Mead & Son.	Jamestown.
Method of growing alfalfa on Volusia soils	4 acres	Bolt & Huey	Watkins.
Method of growing alfalfa on Volusia soils	4 acres	Hon. B. L. Winters.	Smithboro.
Method of growing alfalfa on Volusia soils	2 acres	A. R. Chapple	Sidney.
Tobacco culture		Burton I. Crego	Baldwinsville.
Tobacco culture		T. R. & E. E. Minier	Big Flats.
Tobacco culture		F. J. Patchet	Baldwinsville.

RESULTS OF INVESTIGATIONS.

BACTERIOLOGICAL AND DAIRY DEPARTMENTS.

The production of sanitary milk.— A study of the production of sanitary milk and of the relations of the consuming public to this production have received much attention during the past two or three years. It seems to be very important in the interests of the economy of production to know what factors in the drawing and handling of milk have the most influence upon its germ content. It is, of course, essential that dairy animals be healthy and that persons dangerous to the sanitary quality of the milk be not permitted in the stable, or be in any way connected with the handling of milk. The studies that have been carried on by the Station have pertained rather to barn conditions. Conclusions as to the effect of the use of small-mouthed pails for milking, and of the milking machine, upon the germ content of the milk, have been presented in former reports.

In Bulletin No. 365 are shown the results of studies on the effect of protecting the milk pails from accidental contamination after they have been thoroughly steamed; of whitewashing, and otherwise thoroughly renovating the interior of the stable; of clipping the udder, flank and adjoining portions of the cow; of cleaning the cow with a vacuum cleaner at the rate of one cow per minute, as compared with hand-cleaning at the rate of two cows per minute, and of cooling and straining the milk.

The general result of these studies was to show that, under the conditions present in the Experiment Station barn, the renovating of the interior of the stable, the clipping of the cows and the vacuum cleaning had little or no effect on the germ content of the milk produced. The protection of the milk pails from accidental contamination after steaming did have a measurable effect in lowering the germ content. When all of the utensils were carefully steamed, straining and cooling the milk resulted in only a small increase in germ content even when this was done under what would ordinarily be considered as rather unfavorable conditions.

These results are very hopeful for the average farmer for they show that some dairy operations which have been regarded as essential by many men are really unessential refinements, some of them advisable perhaps under certain conditions, but nevertheless unessential from the standpoint of sanitary milk production.

It should not be understood that the Station would encourage leniency in the maintenance of unsanitary conditions in the barns. There is no question but what the environment and the attendants should be cleanly, thus lessening the dangers of contamination. It is important, however, for the milk producers to know what conditions are most likely to result in milk contamination and what points should be given the closest attention in order to prevent such contamination. We have already studied certain factors and these studies will be continued over a wider range.

Germ content of milk when drawn.— Along this line is a consideration of the germ content of milk when it is drawn. It is well known that milk contains germs which are in it when it is drawn from the udder and which are not due to outside contamination. This is a fundamental question for the producers of certified milk to consider because, as we shall see, milk produced under the most rigid conditions may contain bacteria in much larger numbers than some of the standards which have been set by certain producers of certified milk. Thus studies were begun by the department a number of years ago on the bacterial flora of cheddar cheese, which were reported in Technical Bulletin No. 8. At the same time studies were begun on the bacterial flora of the udder, which have been completed during the past few years and published as Technical Bulletin No. 27. As the result of the study of 1,230 samples of strippings it was found that the milk as drawn from the udder contained an

average of 428 bacteria per cubic centimeter. But inasmuch as the back quarters of the udder were found to contain an average of three times as many bacteria as the fore quarters and inasmuch as the hind quarters furnish more milk than the fore quarters, it is probable that the average germ content of the milk as drawn from the udder would be about 500 bacteria per cubic centimeter. Neither the age of the cow nor the period of lactation was found to exert any marked influence upon the germ content of the udder.

Thus the cow herself in any average herd may be expected to discharge approximately 500 bacteria per cubic centimeter, so that milk containing 500 bactera per cubic centimeter will ordinarily be produced even where extreme precautions are used. This knowledge is of great importance to the certified milk producer and shows again that it is entirely feasible for a man, who is trying to produce a milk with the lowest possible germ content regardless of cost of production, to reduce the germ content of the milk produced by a selection of cows whose freshly-drawn milk normally contains few bacteria.

The controlling factor in the production of sanitary milk.— Much attention has been given during the past few years to the production and distribution of sanitary milk. It is well recognized that milk has important relations to the health of the consuming public and that its production also bears very directly upon the prosperity of thousands of New York dairymen. Various means have been considered, legal and otherwise, for improving the quality of milk. After a careful consideration of the whole question, this institution has consistently held that while both education and law may greatly aid in securing, for the people of our cities, milk of a desirable quality, yet after all that may be done in the way of advising better conditions and enforcing inspection laws, no real progress will be made unless the consuming public recognizes the fact that it must pay enough for milk of a high quality to justify its profitable production. In brief, the financial stimulus is held to be the main factor in securing for public consumption milk of a sanitary quality. It is particularly self-evident that dairymen will not apply faithfully the tuberculin test and scrupulously watch the health of their animals, maintain the conditions of unusual neatness in the stable, give the animal extra cleaning, and insist upon healthy and neat attendants unless they are paid for this extra trouble and expense. Data so far

gathered appear to indicate that while the dairy products of this State exceed in value any other agricultural product, they are undoubtedly produced either on a very small margin, or at a loss. In other words, if milk produced under the old and somewhat indifferent and careless methods is not paying the profits it should, additional expense can not be imposed without additional compensation. It remains for the consumer to appreciate this fact and become willing to pay for milk according to quality.

It was the good fortune of the Station to be able to make observations which, without question, justify the general point of view above set forth. During the years from September, 1907, to March, 1911, a study was made of the influence of publicity and payment based on quality as a means of improving a city milk supply. During this time the dairies supplying milk to this city were carefully and repeatedly scored. Later, the Station found it desirable for the purposes of sanitary milk study to re-score these dairies, which was done several times, and found a very marked change. In the earlier study, the two factors — publicity and financial stimulus — were so closely united that it was not possible to estimate their relative importance. As a result of the changes which occurred, without corresponding changes in prices paid for the milk, it became possible to observe the effect of the removal of the financial stimulus upon the production of clean milk, while practically every other element in the situation remained unchanged.

A study of the economic conditions of the city milk supply in question showed that under present financial conditions the wholesale price of city milk was not high enough to yield the average owner of a dairy a satisfactory interest on his investment. Therefore he was compelled to supply the cheapest grade of milk that the market would accept without reducing the purchase price.

Since the main opportunity for cheapening production was to omit part of the labor and care which were necessary to the production of a clean, sanitary article, this was generally done, a fact which was dicovered by re-scoring the dairies.

Before the removal of the financial stimulus 12.8 per ct. of the dairies supplying milk to the city scored in the "excellent" class and 87.2 per ct. in the "good" class. One year after the change above noted, conditions had so changed that the "excellent" class of dairies had disappeared, while only 18 per ct. scored in the "good"

class and 82 per ct. of the dairies had dropped back into the " medium " class. In a number of cases the tuberculin test was not renewed in the year and the reacting animals removed; the cleaning of the cows was generally omitted and in some cases their bodies were allowed to become well coated with dried excrement; frequently little or no attention was given to the cooling of the milk; cobwebs, dust and general litter accumulated in the stables, and the barn-yards often become choked and muddy from the accumulation of manure. It should be noted that the failure to attend to these details saved money or saved labor, which under present conditions, amounts to the same thing to the producer. It should also be noted that, with the exception of the tuberculin test, there was no single day when any one of the above conditions could have been said to have changed from good to bad. The resulting bad conditions were the cumulative result of a gradual lowering of the standard of doing business.

This investigation is reported in Bulletin No. 363.

An electrical incubator.— An absolute necessity for any bacteriological laboratory is an incubator where constant temperatures, sometimes warmer and sometimes colder than ordinary room temperatures, can be maintained. Such an incubator of a very efficient type has been constructed in the laboratory and because of the fact that its construction involved many new features, a technical bulletin, No. 29, was prepared describing these features for the benefit of similar laboratories.

BOTANICAL DEPARTMENT.

Currant cane-necrosis.— This disease has been very destructive in the Hudson Valley. It has been held that cane-necrosis can be controlled by summer pruning, i. e., by removing the diseased canes at intervals during the summer; but a practical field test of the method, covering six seasons, shows that summer pruning can not be depended upon to keep the disease under control. At no time during the course of the experiment was there any indication that the treatment had materially checked the disease. Details of the experiment are given in Bulletin No. 357.

Seed testing.— Bulletin No. 362 contains an account of the seed work of the Station during 1912. The seed law which went into

effect July 1, 1912, provides that agricultural seed containing more than three per ct. of foul or foreign seeds shall not be offered for sale in the State unless the percentage of impurity be plainly marked on the container. Of the 124 samples examined officially under this law, 19 contained more than the permissible three per ct. of foreign seeds. During the year analyses were made, also, of 1,140 seed samples sent in by farmers and others.

Persistence of potato late-blight.— Experiments reported in Bulletin No. 367 seem to show that the potato late-blight fungus is unable to over-winter in the soil. Hence, so far as late blight is concerned there is no risk in planting potatoes where potatoes blighted or rotted the previous season. However, there are other kinds of potato blight (also scab) which do persist in the soil and rotation of crops is helpful in controlling these.

Disinfection of seed potatoes.— It has been discovered that, in the disinfection of seed potatoes by means of formaldehyde gas as heretofore recommended, the tubers are liable to injury unless the quantity of potatoes treated equals ten pounds or more per cubic foot of space in the disinfection chamber. The property of adsorption is responsible for this. The injury takes the form of sunken brown spots. Liability to injury is increased by sprouting of the tubers and by raising the relative humidity of the air.

Further, it has been found that Rhizoctonia sclerotia on potato tubers are not all killed by the standard treatment with formaldehyde gas or formaldehyde solution recommended for scab. The formaldehyde is unable to penetrate to the center of the larger and more compact sclerotia. Corrosive sublimate, on the contrary, is highly efficient in destroying Rhizoctonia.

Accordingly, it is recommended that when it is desired to treat seed potatoes for Rhizoctonia the corrosive sublimate treatment should be employed. Also, the formaldehyde gas treatment should be used only in those cases in which it is impracticable to use one or the other of the standard liquid treatments. Details of this investigation are given in Bulletins Nos. 369 and 370.

CHEMICAL DEPARTMENT.

Under the head of "Inspection Work," mention has been made of the analyses, performed by this department, of fertilizers, feeding

stuffs and other materials. This work occupies quite a large portion of the time and energy of the department.

The effect of mixing lime-sulphur solution with lead arsenate.— This is an important question which has been raised many times by orchardists. It is desired to use the arsenate as an insecticide in connection with the lime-sulphur for controlling the San Jose scale and apple scab, but it has been asked whether the efficiency of the arsenate is diminished by the combination, or whether it, in any way, becomes dangerous to foliage. It was found that with lead arsenates containing the compound known as di-lead arsenate, some arsenic is made soluble; with lead arsenates containing only tri-lead arsenate, much less arsenic becomes soluble. The amounts made soluble are scarcely sufficient to harm foliage under ordinary conditions.

For some years, the Station has been engaged in a study of the changes taking place in milk when it is converted into cheese. This subject has never been satisfactorily understood and much remains for investigation. As fundamental to these studies, it has been necessary to get at certain underlying technical facts; among these it has been found necessary to investigate the solubility of casein in dilute acids. This work has an important bearing upon the methods used in determining the amount of casein in milk. It was shown that the volumetric method for determining casein (which was devised in this laboratory and which has been described in Technical Bulletin No. 10) admits of quite wide variations in the amount of acid used without impairing its accuracy.

Further study has been made of the action of rennin (this being the enzym contained in rennet extracts and powders) upon casein and an explanation has been offered as to why the ammonium, sodium and potassium compounds, known as caseinates, are not curdled by rennet, and also why some calcium caseinates are curdled by rennin and others are not.

New compounds of magnesium caseinate have been prepared similar to the compounds of calcium described in Technical Bulletin No. 26.

These preliminary studies are time-consuming, but are essential as a basis for further investigations.

ENTOMOLOGICAL DEPARTMENT.

The grape leaf-hopper.— Bulletin No. 359 is a report of studies on the hibernating habits and spring food plants of this insect, and of various experiments to establish efficient spraying practices. As large numbers of the adults went into hibernation during the fall of 1912, unusual opportunities were afforded for studying the insects under winter conditions. Observations showed that the most favorable hibernating places for the leaf-hopper are fence rows, woods, brush and waste land, weeds or situations where leaves accumulate by the wind. Grass which has lodged also affords winter shelter to the insects. It was moreover determined that the drier, well-drained soils are more conducive to the safe wintering of the adults than the heavier soils. It is believed that green cover crops do not afford suitable hibernating places for the grape leaf-hopper, at least during severe winters.

Studies on the food plants of the leaf-hopper show that it feeds on the foliage of raspberry, strawberry, blackberry, currant, gooseberry, catnip, Virginia creeper, burdock, beech and sugar maple before it seeks the grapes. Strawberry and raspberry are the preferred spring food plants. The insects migrate from strawberry to the raspberry during early May and from the raspberry to the grape during the latter part of May.

The foliage of the grape is injured by the overwintering adults but most of the feeding is restricted to the lower leaves, especially those on the young shoots or suckers at the base of the vine. The amount of injury to vineyards varies directly with their proximity to favorable hibernating places and spring food plants.

Spraying experiments during 1912 showed: (1) that Black Leaf 40, one part to 1600 parts of water or bordeaux mixture, is an efficient spray for the leaf-hopper. (2) The automatic attachment is a practical machine in the hands of careful sprayers. (3) The fruit from vines protected from the leaf-hopper is superior to fruit from vines subjected to the attacks of this pest. Chemical analyses of grapes from sprayed vines gave a gain of from 8 to 68 per ct. in sugar over those from untreated vines, while the unsprayed grapes had from 0 to 20.6 per ct. more acid than sprayed grapes.

The destruction of hibernating places of the grape leaf-hopper

is recommended as a method of control, especially to save the young foliage of the grape in the spring.

When hibernating adults are on the young foliage, delaying the removal of the young shoots at the base of the vine will tend to keep the insects on the lower leaves and thus afford some protection to the more permanent foliage. The lower shoots should be removed just previous to spraying.

The false tarnished plant-bug as a pear pest.— In Bulletin No. 368 attention is called to an investigation which was undertaken to determine the nature and habits of the causal agent in the production of a diseased condition of pears, characterized by the cracking open of the skin in small spots and the formation of protruding granular areas. The studies conducted to this end have demonstrated that the injuries are largely caused by a true sucking plant-bug (*Lygus invitus* Say). The damage is done by the nymphs, which attack both pear fruit and foliage. Grape blossom clusters are also subject to attack. The adult is similar in appearance to the well-known tarnished plant-bug which thrives on a large variety of plants. The similarity in appearance of the adults of these two insects suggested as a common name, for the former species, false tarnished plant-bug.

As is common with insects of this class, this species proves to have five nymphal stages. The nymphs of the first two instars are pale, fragile creatures which are very active and subsist largely on the juices of the tender foliage. In the older stages they are more sedentary and attack both leaves and fruits. The habit of feeding in rather restricted areas is responsible for serious injuries to young pears. The destructive activities of the insects occur during the period coincidental with the conclusion of pollination and the formation of the fruit.

Experiments conducted by the Station during the past three years have demonstrated that spraying as blossoms drop largely prevents the formation of the young pears. The spraying mixture that is recommended is three-fourths of a pint of tobacco extract (40 per ct. nicotine) to one hundred gallons of water to which are added three pounds of dissolved soap. Thorough applications, using liberal quantities of the spray, are essential to accomplish the desired purpose.

Zinc arsenite as an insecticide.— Technical Bulletin No. 28 deals with a series of experiments with zinc arsenite and lead arsenate to determine their relative toxicity to insects and the safeness of zinc arsenite for use on foliage.

In field and laboratory tests one pound of zinc arsenite proved equal in effectiveness to three pounds of lead arsenate.

Zinc arsenite when added to calcium hydrate or bordeaux mixture caused no injury to apple foliage; but more or less spotting of apple leaves occurred when the poison was used singly or in combination with lime-sulphur or glucose. Zinc arsenite alone or with glucose caused severe burning of grape foliage. Laboratory tests indicate that the injury to foliage by zinc arsenite may be due in part to the solubility of the poison in carbonic acid.

The contradictory results from the use of zinc arsenite on foliage suggest that the poison as manufactured is not a stable or uniform product.

Zinc arsenite or lead arsenate with bordeaux, soap or glue continued effective for twenty-five days. Either of the poisons alone or with glucose gradually lost its poisonous properties on exposure to weather and by the end of this period had ceased to protect the foliage.

Incidental to the main problem it appears in these tests that the lime-sulphur solution does not resist wet weather as well as bordeaux mixture.

The influence of temperature and moisture in fumigation.— Failure to kill hibernating caterpillars of the browntail moth in importations of foreign shipments of nursery stock led to a demand on the Station to determine the conditions which rendered fumigation ineffective. In Technical Bulletin No. 30, attention is called to a series of fumigation tests in which the effectiveness of the treatments were influenced by temperature and humidity. A greater number of caterpillars survived the fumigations made at low temperatures than at higher temperatures; also fumigations made under humid conditions were uniformly more destructive to the larvæ than tests that were conducted in a relatively dry air.

The bulletin closes with a general discussion on the resistance of the caterpillars of the browntail moth to fumigation and the effects of variations of temperature and moisture on this condition. It is concluded that the unusual resistance of these caterpillars to fumigation is due to a condition of hibernation in which the moisture

content of the body is low and the insects are comparatively inactive. It is possible that the spiracles are partially closed, which would also lessen the effect of the gas. A rise in temperature is correlated with greater effectiveness, but this increase in the deadly properties is more apparent between fifty and seventy degrees than at lower temperatures. A dry air is not favorable to fumigation with cyanide when the insects are in a hibernating state, which suggests that the low moisture content which usually accompanies this condition is one of the factors that help modify the effect of the gas.

The pear psylla.— Circular 20 from this department is a popular treatise, illustrated with two plates and a number of text figures, on this species of psylla, which is regarded as one of the principal enemies of pear orchards. The different life stages are described and figured, and seasonal history discussed. Attention is directed especially to the habits of the hibernating adults during the late fall, winter and early spring and to their activities during the period of oviposition. Detailed instructions are given for a number of spraying practices which are directed to the killing of the hibernating flies to reduce the extent of oviposition, and to the destruction of eggs and the first-brood nymphs.

The false tarnished plant-bug.— Circular 21 calls attention to the work of this insect, which has been very troublesome to pear-growers in certain localities in western New York. A brief account is given of the life history and habits of the pest. The circular concludes with short spraying directions for the prevention of injury.

The control of plant lice on apple trees.— Circular 23 is a short memoir, dealing with the more destructive species of plant lice attacking apple trees. An account is given of the habits of the insects which are responsible for injuries to foliage and fruit and general suggestions are given for the protection of bearing orchards.

Apple insects.— Circular 25 deals with the following insects: Pistol case-bearer, cigar case-bearer, bud moth, oblique-banded leaf-roller, fruit tree leaf-roller, apple red-bugs, green fruit worms, codling moth, lesser apple worm, palmer worm, plum curculio, tussock moth, apple maggot, gipsy moth and browntail moth. A brief life history is given of each and concise directions for treatments. The memoir concludes with a spraying calendar, with instructions for the application of lime-sulphur as a general insecticide.

DEPARTMENT OF HORTICULTURE.

Apples, old and new.— In Bulletin No. 361 an attempt is made to answer the oft-repeated question, "What apples shall I plant?" The introduction of new varieties and the uncertainty as to old ones make it necessary for some one to grow varieties of apples on probation in fruit-growing regions. To test varieties of fruits is a money-taking, time-consuming task, which requires not only the good judgment of an expert fruit-grower but wide and thorough knowledge of varieties. Manifestly, it is work for an experiment station and not for an individual. The New York Station attempts to test every variety of fruit obtainable that will thrive in this climate. Bulletin No. 361 is one of several publications from this Station giving results of tests of old and new apples. Eight hundred and four varieties of apples are listed with the statement of their origin, age at which they come into bearing on the Station grounds and description as to form, size, color, flavor, quality, use and season. The State is divided into nine pomological regions and a list of varieties given for each. This list is founded upon the behavior of the varieties in each region as to size, color, keeping quality and flavor of fruit; and as to longevity, vigor, health and productiveness of trees.

Studying these eight hundred and four varieties has thrown light on several phases of apple-growing and these are discussed under the following heads,— First, *Groups of apples.*— Varieties of apples are classified into groups in accordance with their blood relationships. These groups are of importance because each has marked adaptations to particular conditions and the grouping is a real help many times as a guide to apple-growers in seeking what to plant.

Second, *Strains of apples.*— As dividing apples into groups of varieties, helps in determining adaptation and, therefore, what to plant; so, the division of varieties into strains may be helpful if the strains are real and not fanciful. Strains arise through bud variations, long known to fruit-growers as sports, but recently dignified by De Vries as mutations. Strains so arising, in apples, in particular, usually differ from the parent varieties in one or at most of but a few characters.

Third, *Degeneration of apples.*— It is held that from all evidence to be had the fruit-grower is as safe in assuming that for practical

purposes varieties of apples do not degenerate and neither do they change for the better.

Fourth, *Natural resistance to disease in apples.*— It means much in selecting varieties to know which are immune or susceptible to uncontrollable diseases as fire blight or peach yellows. This subject, too, it is obvious, is a most important one to plant breeders. The two diseases of apples discussed in this connection are apple scab and apple blight.

Fifth, *Seedless apples.*— Seedlessness is a valuable character in many fruits. It may become so in the apple. A consideration of this fact is followed by a list of growers of different varieties of seedless apples reported in the United States during the past twenty years.

New or noteworthy fruits.— Bulletin No. 364 contains a description of a number of new or noteworthy fruits. Without new varieties fruit-growing would be at a standstill. Old varieties are seldom improved and are changed only when nature has occasionally substituted one character for another as when russet takes the place of red in the Baldwin or of yellow in the Bartlett. All this means then that new varieties are milestones in the march of progress and that fruit-growers to keep up in the march must become familiar with the milestones. In this bulletin, too, are described the best recent introductions of varieties of tree, bush and vine fruits as they grow on the grounds of this Station.

For one reason or another varieties are often lost. Some of these all but lost varieties when resurrected and given a second period of probation prove most worthy. Again, the defectives and unmanageables of a generation ago may, under improved methods, prove tractable and profitable. These are the "noteworthies" of the title — old sorts never tried or not well tried, or one-time "unmanageables" which after a more careful test or with a better show deserve the attention of fruit-growers. The following fruits are described in this bulletin:—Apples: Deacon Jones, Delicious, Opalescent. Pears: Lucy Duke. Peaches: Arp Beauty, Frances, Miss Lola. Plums: Imperial Epineuse, Middleburg, Pearl, Tennant. Cherry: Schmidt. Grapes: Berckmans, Delago, Eclipse, Secretary. Raspberries: June, Plum Farmer. Currants: Perfection, Diploma. Gooseberry: Poorman. Strawberries: Prolific, Chesapeake.

The setting and dropping of fruits.— Circular No. 22 discusses the whole matter of the setting and dropping of fruits. Failure to set fruit even though the trees bear an abundance of blossoms, the dropping of immature fruits, the biennial bearing habit of certain apples and unfavorable weather at blooming time, are common and seemingly unpreventable drawbacks to profitable fruit-growing. In this circular the above problems are discussed, first, as having to do with the formation of fruit buds; second, as having to do with the development of the buds.

Orchard management.— Circular No. 24 contains specifications for fruit-growing in New York under the heads of selection of orchard soils, selection of varieties, selecting trees, "pedigreed" trees, stocks for trees, laying out the orchard, impotency of varieties, time to set and age of tree, use of dynamite in digging holes, top-working young trees, pruning at transplanting time, height of head, form of head, pruning for wood, pruning for fruit, time to prune, cultivating the orchard, fertilizing an orchard, inter-crops and cover-crops, pests and mice and rabbits.

PUBLICATIONS ISSUED DURING 1913.

BULLETINS.

No. 357. February. An experiment on the control of current cane-necrosis by summer pruning. F. C. Stewart. Pages 10. Popular edition, pages 2, fig. 1.

No. 358. February. Studies in plant nutrition. I. a. The unlike feeding capacity of different species of agricultural plants. b. The influence of fineness upon the availability of ground phosphatic rock. c. The fertilizing value of an iron ore waste. W. H. Jordan. Pages 20.

No. 359. February. The grape leaf-hopper. F. Z. Hartzell. Pages 20, plates 6, figs. 3. Popular edition, pages 4, plates 2, fig. 1.

No. 360. February. Studies in plant nutrition. II. The necessary supply of plant food. W. H. Jordan. Pages 25, figs. 8.

No. 361. March. Apples: Old and new. U. P. Hedrick and G. H. Howe. Pages 57. Popular edition, pages 12, fig. 1.

No. 362. February. Seed tests made at the Station during 1912. M. T. Munn. Pages 27. Popular edition, pages 10, fig. 1.

No. 363. April. The financial stimulus in city milk production. H. A. Harding and J. D. Brew. Pages 14, fig. 1. Popular edition, pages 8, fig. 1.

No. 364. July. New or noteworthy fruits. U. P. Hedrick. Pages 17, colored plates 4. Popular edition, pages 10, colored plate 1, fig. 1.

No. 365. August. The effect of certain dairy operations upon the germ content of milk. H. A. Harding, G. L. Ruehle, J. K. Wilson, and G. A. Smith. Pages 37. Popular edition, pages 8, fig. 1.

No. 366. August. Inspection of feeding stuffs. Pages 122.

No. 367. October. The persistence of the potato late-blight fungus in the soil. F. C. Stewart. Pages 5. Popular edition, pages 2, fig. 1.

No. 368. November. The false tarnished plant-bug as a pear pest. P. J. Parrott and H. E. Hodgkiss. Pages 21, plates 8, figs. 11. Popular edition, pages 8, plates 3, figs. 2.

No. 369. December. The injurious effect of formaldehyde on potato tubers. F. C. Stewart and W. O. Gloyer. Pages 32, plates 2. Popular edition with No. 370, pages 10, fig. 1.

No. 370. December. The efficiency of formaldehyde in the treatment of seed potatoes for Rhizoctonia. W. O. Gloyer. Pages 14, plate 1. Popular edition with 369, pages 10, fig. 1.

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No. 372. December. Director's report for 1913. W. H. Jordan. Pages 26.

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W. H. JORDAN.

NEW YORK AGRICULTURAL EXPERIMENT STATION,
Geneva, N. Y., December 31, 1913.

REPORT

OF THE

Department of Bacteriology.

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[1] Resigned May 15, 1913.
[2] Appointed August 1, 1913.
[3] Resigned in 1912.

REPORT OF THE DEPARTMENT OF BACTERIOLOGY

THE FINANCIAL STIMULUS IN CITY MILK PRODUCTION.*

H. A. HARDING AND J. D. BREW.

SUMMARY.

1. Under present financial conditions the wholesale price of city milk is not high enough to yield the average owner of a dairy a satisfactory interest upon his investment. Therefore he is compelled to supply the cheapest grade of milk that the market will accept without reducing the purchase price.

2. The main opportunity for cheapening production is to omit the labor and care which are necessary to the production of a clean sanitary article.

3. The financial stimulus is the strongest force which can be enlisted in the improvement of municipal milk supplies. Milk supplies will never become better as long as the largest profit is attained by the production of dirty milk. However, they will improve when consumers are able to buy graded milk which they are sure is true to grade.

INTRODUCTION.

Bulletin No. 337[1] of this Station gives the record from September, 1907, to March, 1911, of the changes in sanitary quality of the milk supply of a city of 13,000 people as supplied by 550 cows distributed among 40 dairies. The object of that publication was to call attention to publicity and payment based on quality as potent factors in the improvement of city milk supplies.

In that study the quality of the milk was estimated by scoring the dairies according to the Cornell Dairy Score Card devised by Dr. R. A. Pearson. The facts regarding the individual dairies were ascertained by the city sanitary inspector and the scores were apportioned by one of the authors (H) of this article.

[1] Publicity and payment based on quality as factors in improving a city milk supply. H. A. *Harding*, N. Y. Agr. Exp. Sta. Bul. 337. 1911.

* *Reprint* of Bulletin No. 363, April, 1913; for Popular Edition, see p. 749.

In this former study the two factors, publicity and the financial stimulus, were so closely united that it was not possible to estimate accurately their relative importance.

As the result of changes in conditions, for which the authors are in no way responsible, it is now possible to observe the results from removing the financial stimulus to the production of cleaner milk while practically every other element in the situation remains unchanged. This publication is designed to show the results of the removal of this stimulus as measured by the sanitary conditions surrounding the production of the milk supply.

It is generally recognized that the scores given to a dairy by two inspectors will vary somewhat even when scoring according to the same card. Accordingly, before making any deductions from the present and former scores it is well to consider whether they are comparable.

The method of arriving at the scores in the former publication has already been given. In the present statement the facts regarding the dairy conditions have been obtained by one of us (B) and the rating of these conditions has been fixed by the other one (H). It is true that the facts regarding the lapse of time since the last tuberculin test, the prevalence of cobwebs and litter in the stables, the number of cows which were incrusted with their own dried excrement, the temperature to which the milk was cooled and similar information were collected by two different individuals. However, since these are questions of fact which can be readily and quite accurately determined, there is no reason to think that these observations by the two men differed in any important particular. Since the valuations of these facts were made by the same individual in both cases, using the same standard of cuts for undesirable conditions, it seems safe to conclude that the two sets of scorings are fairly comparable.

Accordingly, the contrast between the actual conditions of milk production where the financial stimulus toward cleaner milk production was present and where it was absent is offered as a contribution toward the solution of the vexed question of better city milk supplies.

BASIS OF SCORING.

The score card which has been used throughout the entire study of this milk supply and upon which the contracts between the producers and the retailers were based is the one devised by Dr. R. A. Pearson while he was at the head of the dairy department in Cornell University and is known as the Cornell University Dairy Score Card. The front and the back of this score card are shown on the following two pages.

CITY OF ____________

Score Card for Production of Sanitary Milk.

Date ________ Dairy of ____________ P. O. ____________

Retailed by ____________________

		Perfect.	Score.	Cuts.
1. HEALTH OF THE HERD AND ITS PROTECTION.	Health and comfort of the cows and their isolation when sick or at calving time..	45		....
	Location, lighting and ventilation of the stable..........................	35		....
	Food and water......................	20		....
	Total..........................	100		
2. CLEANLINESS OF THE COWS AND THEIR SURROUNDINGS.	Cows...............................	30		....
	Stable.............................	20		....
	Barnyard and pasture..................	20		....
	Stable air (freedom from dust and odors).	30		....
	Total..........................	100		
3. CONSTRUCTION AND CARE OF UTENSILS.	Construction of utensils and their cleaning and sterilizing......................	40		....
	Water supply for cleaning and location and protection of its source...........	25		....
	Care of utensils after cleaning...........	20		....
	Use of small-top milking pail...........	15		....
	Total..........................	100		
4. HEALTH OF EMPLOYEES AND MANNER OF MILKING.	Health of employees..................	45		....
	Clean over-all milking suits and milking with clean, dry hands................	30		....
	Quiet milking, attention to cleanliness of the udder.........................	25		....
	Total..........................	100		
5. HANDLING THE MILK.	Prompt and efficient cooling............	35		....
	Handling milk in a sanitary room and holding it at a low temperature...........	35		....
	Protection during transportation to market	30		....
	Total..........................	100		
	TOTAL OF ALL SCORES........	500		

If the total of all scores is	And each division is	The sanitary conditions are
480 or above	90 or above	EXCELLENT.
450 or above	80 or above	GOOD.
400 or above	60 or above	MEDIUM.
Below 400	Or any division is below 60	POOR.

The sanitary conditions are ____________ Scored by ____________

A BRIEF DESCRIPTION OF WHAT CONSTITUTES PERFECT UNDER EACH HEADING.

1. **HEALTH.** No evidence of chronic or infectious disease or of acute disease in any member of the herd on the dairy premises. Freedom from tuberculosis proven by the tuberculin test made within one year.

   COMFORT. Protection from weather extremes. Stall comfortable,— at least 3′ wide for a small cow, or 3½′ for a large cow; length of stall sufficient for cow to rest easily. Sufficient bedding. Frequent out-door exercise.

   ISOLATION. Removal of cows to comfortable quarters outside of the dairy stable, when sick or at calving time.

   LOCATION OF STABLE. Elevated, with healthful surroundings.

   LIGHTING. As light as a well lighted living room, and with not less than four square feet for light from the east, south or west, for each cow.

   VENTILATION. An adequate ventilating system of the King or other approved pattern, and, except when the stable is being cleaned, no marked stable odor.

   FOOD. Clean, wholesome feeding stuffs, fed in proper quantities.

   WATER. Clean, fresh water, free from possibility of contamination by disease germs.

2. **COWS.** Cleaned by thorough brushing, and where necessary by washing; no dust nor dirt on the hair (stains not considered). The udder thoroughly cleaned by brushing at least thirty minutes before milking, and by washing just before milking, leaving the udder damp to cause dust to adhere.

   STABLE. Free from accumulation of dust and dirt except fresh manure in the gutter. Apart from horses, pigs, privy, poultry-house, etc.

   BARNYARD AND PASTURE. No injurious plants, no mudhole nor pile of manure or any decaying substance where cows have access.

   STABLE AIR. Free from floating dust and odors. Tight partitions or floor between the space occupied by cows and that used for storage of feed or other purpose.

3. **CONSTRUCTION OF UTENSILS.** Non-absorbent matter and every part accessible to the brush, and, except inside of tubes, visible when being cleaned.

   CLEANING. Thorough cleaning with brush and hot water, and rinsing. No laundry soap. Thorough sterilizing.

   WATER. From a source known to be pure; protected from contamination from seepage, or surface drainage.

   CARE OF UTENSILS. Such as to avoid contamination by dust as well as coarser dirt.

   SMALL-TOP PAIL. With opening not over seven inches in diameter, and at least one-third of this opening protected by hood.

4. **EMPLOYEES.** Free from contagious disease and not dwelling in or frequenting any place where contagious disease exists.

   MILKING SUITS. Freshly laundered and clean; ample to protect from dust and dirt, from the milker's person or clothing.

   MILKER'S HANDS. Hands and teats dry when milking. Hands thoroughly cleaned before milking each cow.

5. **COOLING.** Cooled within fifteen minutes of milking, to temperature below 50 degrees F.

   HANDLING. In a room used exclusively for handling milk, and free from dust, dirt and odors; and the milk after being cooled, always at a temperature below 50 degrees.

   PROTECTION DURING TRANSPORTATION. Protected from dirt by tightly closed receptacles, temperature always below 45 degrees F.; not delayed in transit, reaching market within twenty-six hours after milking.

The facts regarding the dairy conditions were determined by one or more visits of the inspector to the dairy at milking time supplemented by occasional tests of the temperature of the milk when delivered to the retailer. In reducing the conditions as found

to a numerical basis a dairy was credited as perfect in each particular unless some objectionable condition or practice was found. Cuts or deductions from the perfect score were made in accordance with the following schedule, the aim being to make identical cuts for similar conditions:

SCORE CARD CUTS USED.*

HEALTH OF HERD AND ITS PROTECTION.

No tuberculin test, 12.
Old tuberculin test (over one year), 12.
Rigid stanchions (not cut when cows were confined only during milking, as in summer), 3.
Light, 1 to 5, according to conditions.
No special system of ventilation, 2.
Ventilation, 1 to 5.
No comfortable provision for isolation or calving outside of stable containing milking cows, 5.
Stable poorly built to protect from the weather, 1 to 5.

CLEANLINESS OF COWS AND THEIR SURROUNDINGS.

Manure or dust on cows, 1 to 10.
Hair about udders not clipped, 1.
Damp cloth not used on udders before milking, 2.
Litter or roughage on stable floor, 1 to 5.
Ceiling not tight, 1 to 5.
Cobwebs and dust in stable, 1 to 5.
Stable not whitewashed within one year, 5.
Horse in cow stable, 5.
Manure not removed once per day, 1 to 10.
Manure or mud in barnyard to which cows have access, 1 to 10.
Feeding dry feed just before milking, 1 to 10.
Objectionable odors in stable, 1 to 5.

CONSTRUCTION AND CARE OF UTENSILS.

Insufficient cleaning, 1 to 5.
No special sterilization (no steam), 5.
No small-topped pail, 15.

HEALTH OF EMPLOYEES AND MANNER OF MILKING.

No special clean milking suits, 5.
Dirty suits, 1 to 5.
Milking with wet hands, 10.
Unclean hands, 1 to 6.

HANDLING THE MILK.

Not efficiently cooled (50° F. or below).
 50° to 60°, cut 5.
 61° to 70°, 10.
 above 71°, 15.
Not held at 50° F. or below, 5.
Milk strained in stable, 5.
Milk room not clean, 1 to 5.
No milk room, 3.

* These were the cuts as applied to actual conditions. More unsanitary surroundings would merit greater cuts than those indicated.

SUMMARY OF PAST CONDITIONS.

In order to make the results of the study of sanitary conditions surrounding the production of milk in this city more easily understood the inspection findings were grouped as indicated on the score card (page 39) under the following headings: Poor, including filthy conditions; medium, where conditions were merely dirty; good, where conditions were fairly clean; excellent, where they were both clean and sanitary.

A careful initial inspection in 1907 showed that 5 per ct. of the dairies were "good," 57.5 per ct. "medium" and 37.5 per ct. "poor." The influence of publicity was immediately brought to bear on the situation. Gradually the milk producers and retailers became convinced of the accuracy and usefulness of the official scores, with the result that by the beginning of 1911 practically all of the milk was being sold by the producers to the retailers on sliding-scale contracts. These contracts stipulated that the milk must be produced and delivered in accordance with the requirements of the board of health and that the price for each quarter should be based upon the official score given the producer by the board of health, no milk to be accepted when below the grade of medium and the price to increase one-half cent per quart with each grade above. The economic force which made profitable the payment of this bonus for better grades of milk was the publicity given by the board of health to the sanitary conditions present in each dairy as well as the name of the person or firm retailing the milk in the city. Under such conditions each retailer found it financially profitable to stimulate the production of cleaner milk because of the influence of the official report upon the public demand for his goods.

Under the joint action of these two factors, publicity and payment based on quality, the sanitary conditions surrounding the milk supply steadily improved until the report for March, 1911, showed that 12.8 per ct. of the dairies ranked as "excellent" and 87.2 per ct. "good." The "poor" grade had disappeared quickly before the light of publicity and the "medium" grade had decreased steadily and finally had disappeared.

Thus, by the observance of the simplest economic laws, an exceptionally satisfactory milk supply was provided at a cost to the municipality of $500 per year for the additional salary of the sanitary inspector. It should be noted, however, that the vital point in this plan was the voluntary acceptance by all parties of the official scores of the dairies as a satisfactory basis for doing business.

FINANCIAL MAGNITUDE OF THE MILK BUSINESS.

In response to the general public demand for better milk supplies attempts at improvement have been made in practically all of the larger, and in many of the smaller, cities. Too frequently these

attempts have not taken into consideration the financial magnitude of the business interests which they have undertaken to control. Neither have they questioned whether their efforts were in accord with or opposed to the economic laws which apply to the milk business.

This lack of familiarity with the financial side of the milk business on the part of milk reformers is partly due to the fact that but a small part of the investment is apparent to them and largely because detailed information on this phase of the subject has not been brought to their attention.

In the present instance nothing approximating a census has been attempted, but personal estimates regarding the financial magnitude of the various items have been kindly furnished by several persons most familiar with local conditions. These estimates have been carefully weighed and figures selected which, while they are believed to represent the facts fairly, are considered distinctly conservative. These figures, together with an estimate of their relative accuracy are as follows: Stimulated by the increased demand for milk, the dairies have been increased to 41 and the number of cows to almost exactly 600. This number varies slightly on account of the buying and selling which are constantly occurring among the various dairies, but the error at any given time will probably be less than 3 per ct. The average value of the animals is more uncertain. About one-third of these cows have changed hands recently at prices averaging above $110 each, but it is undoubtedly true that these are the better cows. Estimates of average value have ranged from $65 to $100. Somewhat detailed estimates on the basis of known values of a considerable number of the herds indicate that an average value of $80 is probably accurate.

It is a matter of practically unanimous agreement that in this region a well balanced dairy farm must devote five acres to each cow. This leads to the conclusion that 3,000 acres of land are required in order to support the 600 cows. The value of this land is again a variable factor. Much of it lies within a few miles of the city and is held at $100 to $150 per acre. A few of the farms are less favorably located. An estimate of $100 per acre is considered conservative.

In order to support the cows the farms must be equipped. Aside from the buildings, the value of which is included with the land the most expensive single item of equipment is horses. Since the average dairy would contain 15 cows and the farm 75 acres the estimate of equipment has been based on the results of known auction sales of similar farms supplemented by known expense of equipment on a few farms. The estimate of $1,500 per farm or $20 per acre for equipment in addition to the buildings and cows errs on the side of being too low.

The capital invested in the city distributing end of the business is in connection with two large milk companies and two distributers

of the product from single dairies. Estimates from various sources differ slightly but $50,000 appears to be conservative.

These detailed estimates are assembled below:

CAPITAL INVESTED IN SUPPLYING MILK TO CITY WITH 13,000 INHABITANTS.

Cows — 600 at $80	$48,000
Land with buildings — 3,000 acres at $100	300,000
Equipment — 3,000 acres at $20 per acre	60,000
City distributers	50,000
Total	$458,000

Because of the magnitude of these totals and of the fact that they are based upon estimates many will feel that they are too high. Appreciating this fact the above conservative estimates were accepted notwithstanding the conviction of the authors that were complete information available the grand total would be at least 10 per ct. higher.

The State Department of Health bases its mortality statistics for this city on an estimated population of 12,574. Using this figure for the population, the above estimate of dairy capitalization amounts to $36.42 per capita of the people being supplied with milk. Considered from the agricultural standpoint the capitalization amounts to $763 per cow of which the producer furnishes $680 and the retailer $83.

MARGIN OF PROFIT.

The margin of profit of the individual producer can not be accurately calculated without exact information regarding capital invested, expense of operation and returns. On the other hand the average financial returns from the business as a whole can be calculated from more general data and are even more instructive when considering the workings of a plan for milk improvement. The following financial analysis indicates how narrow is the margin of average profit. It is this meagerness of financial return which makes the dairy business respond so quickly to any opportunity for increased gain.

The income from these dairies is practically confined to the sale of milk and some calves for veal and the accumulation of fertilizer. The value of the fertilizer and of the veal is difficult to determine. The amount of milk produced per cow may be estimated from the yearly receipts of the two large retailers. While the number of cows in the dairies varies somewhat during the year the receipts of these retailers indicate that the annual production is approximately 2,800 quarts per cow. This is markedly more than the average annual production for the State, which has been estimated[2] at 4,500 lbs., or 2,100 quarts. However, a high production is to

[2] The individual animal as the unit in profitable dairying. G. A. Smith, N. Y. Agr Exp. Sta. Bul. 322. 1910.

be expected here from the fact that many of the herds are composed of carefully selected, high-priced animals.

The producers have been receiving 3.5 to 4 cents per quart for their milk delivered to the retailer, the variation depending upon the sanitary conditions surrounding its production. The careful records of a herd[3] producing almost exactly 2,800 quarts per cow show that the cost of the food consumed by such cows has been steadily increasing and in 1908 amounted to 2.09 cents per quart of milk produced. Inasmuch as the producer has an investment of $680 per cow, if he is to receive 6 per ct. on his investment, he should get $40.80 per year or 1.45 cents per quart to pay this interest on his investment. Since the food cost amounts to 2.09 cents and the interest on the investment to 1.45 cents per quart the sum of these, or 3.54 cents, must be deducted from the wholesale price of the milk in determining the balance left to pay the other expenses of operation of the dairy and of delivery of the milk to the retailer.

On the basis of the above figures it is plain that the producer who is selling his milk at 3.5 cents per quart is getting slightly less than the value of the fertilizer and veal to offset his expense for labor and supervision. On the same basis the producer selling at 4 cents per quart has a margin of 0.45 cents per quart in addition to the fertilizer and veal to balance his running expenses. It should be noted in this connection that this latter class of producers have gone to extra expense in keeping their herds tuberculin tested and in otherwise improving their sanitary conditions and this entails an added expense which will consume a considerable portion of the increased margin of profit.

The financial situation of the average producer may be summarized by saying that he spends his time in growing crops to make milk to get fertilizer to grow more crops to make more milk to get more fertilizer. He continues in business because he accepts less than 6 per ct. upon his capital invested. His financial salvation depends upon increasing the productivity of his land to the point where it takes less than five acres to support a cow and increasing the productivity of his cows so that they will produce more than 2,800 quarts per year. A part of the solution of his difficulties lies in the possibility of an increased wholesale price for his product.

The financial margins of the retailer are less clearly understood. He is dealing in a very perishable product, he has a source of supply which varies greatly in volume during the year and is supplying a market which is subject to daily and monthly variations in demand. He is disposing of his goods in small amounts, pints and quarts, and the containers are fragile and expensive. Moreover, he is being put to an increasing expense in the matter of machinery and of supervision and he is being constantly hedged about by legal restrictions. Finally his relative expenses of operation vary greatly with the volume of business. Detailed statements recently fur-

[3] See footnote 2.

nished by one of the large retailers of Boston[4] indicate that in their large business their expenses for handling milk amounted to 4.77 cents per quart. In this smaller city where some of the expense items are smaller the margin between the 3.75 cents per quart which goes to the producer and the 7 cents paid by the consumer is only 3.25 cents per quart. It is therefore evident that the business here must be even more economically conducted than in the city of Boston. The fact that the largest retailing company, which has been in business eight years, has never paid over 7 per ct. on its stock indicates that the margin of profit is not very wide.

Under the contracts between the producer and the retailer, as already explained, the wholesale price increased one-half cent per quart from the medium to the good or from the good to the excellent grades. From the preceding analysis it is plain that a decrease of one-half cent per quart in the wholesale price would practically wipe out the margin of profit in milk production.

While it is true that not every objectionable practice would merit a cut sufficient to change the classification of the milk, such would frequently be the case and in some instances a change of two grades might result from a combination of unsanitary practices.

Under such circumstances the power of the inspector to enforce good sanitary conditions surrounding a milk supply is very great and practically its only limit is the readiness with which the milk men can refuse to abide by his action if the inspector abuses his power and forfeits their respect.

The potency of this power when rightly used is seen in the remarkable way in which the sanitary conditions surrounding this milk supply improved during the period between 1907 and 1911.

MILK SUPPLY SITUATION CHANGED.

APPOINTMENT OF DAIRY INSPECTORS.

Under conditions as here outlined where the dairy inspector was virtually the financial arbitrator in a business capitalized at $458,000 it is vital to the success of any plan for milk improvement that he be a man qualified for the important duties which he is to perform.

In all cities in this State it is necessary to make appointments from lists furnished by the local civil service commissions. There is frequently considerable difficulty in getting these commissions to appreciate the technical character of the requirements for dairy inspectors. In Bulletin 337[5] are given in detail the circumstances leading up to the appointment of the first dairy inspector, a railroad baggage-master whose agricultural experience was restricted to his boyhood on a fruit farm. In that instance he was trained by a member of the board of health and by attendance at the Short

[4] H. P. Hood & Sons. Cost of delivering a quart of milk to the consumer. *Hoard's Dairyman*. 41 : 859. Ju. 19, 1912.

[5] See footnote 1.

Course in Agriculture at Cornell University with the result that he eventually became an efficient inspector.

Early in 1911 the member referred to above withdrew from the board of health and later in the year the dairy inspector resigned to enter the postal service.

The vacancy in the position of dairy inspector has since been twice filled by the board of health from eligible lists furnished by the Civil Service Commission. Neither of these inspectors has had anything which could reasonably be considered as a preparation for the technical work of sanitary scoring of dairies.

The character of these appointments and the results upon the milk situation which followed them indicate clearly that there must be a radical change in the prevailing point of view regarding the qualifications for municipal appointments before we shall have a public service which will command the respect and cooperation of the milk producers and retailers. Without such respect and cooperation practically nothing can be accomplished.

REACTION OF THE INSPECTION UPON THE CONDITIONS OF PRODUCTION.

The position of an untrained inspector, made responsible for dairy scoring when the financial importance of his scoring is so great, was not an enviable one. His main source of guidance was the detailed scores of the dairies as they had been given by his predecessor. It was a natural assumption that these scores were fairly correct measures of the existing conditions. Under such circumstances fine distinctions were impossible and it was the natural tendency to repeat the gradings previously given.

The results of the inspections as given by the quarterly reports of the board of health indicated that the sanitary conditions surrounding the production of the milk supply had remained practically unchanged, the report for Dec. 31, 1912, showing 10 per ct. of the dairies as "excellent" and 90 per ct. as "good." These reports were gratifying to the public since they indicated the continuance of satisfactory sanitary conditions and they were satisfactory to the producers since they insured the continuance of the prevailing prices for milk.

The authors have been engaged for some time on a comparative study of various dairy score cards. In August, 1912, they were being aided in this study by Mr. F. H. Bothell, of the Dairy Division of U. S. Department of Agriculture, a man of wide experience in the sanitary scoring of dairies. In company with Mr. Bothell and Mr. G. A. Smith, Dairy Expert at this Station they inspected 15 of the dairies supplying this city in connection with these score card studies. At this time it was evident that, notwithstanding the favorable reports given by the city inspector, the sanitary conditions surrounding the milk production had deteriorated very markedly.

The conditions were again determined by an inspection of the dairies by one of us (B) during the last quarter of 1912, and all of the dairies were again visited during January and February of 1913. In each case the facts as they existed were noted at the time of the visit and the reduction of this to a numerical score was supervised by the other author (H). Using the same standard of cuts and

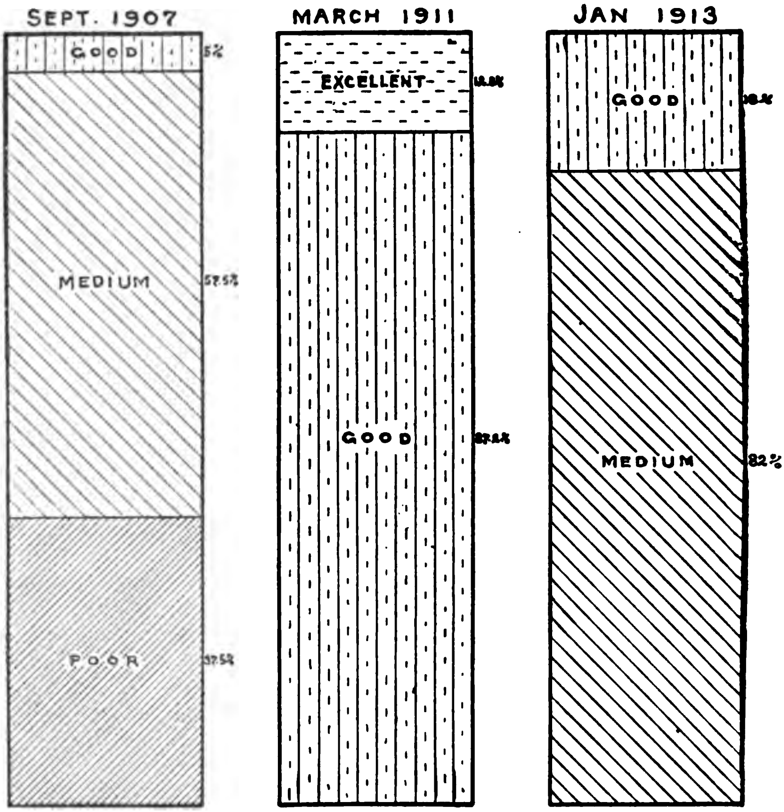

FIG. 1.— CHANGE IN SANITARY QUALITY OF CITY MILK SUPPLY.

making the scorings in all particulars as comparable as possible with the scoring made in March, 1911, when the results were 12.8 per ct. "excellent" and 87.2 per ct. "good," the inspections made in January and February, 1913, gave 18 per ct. "good" and 82 per ct. "medium."

The magnitude of this change in conditions is shown graphically in Fig. 1.

The nature of these changes in sanitary conditions is extremely suggestive. In a number of cases the tuberculin test was not renewed within the year and the reacting animals removed; the cleaning of the cows was generally omitted and in some cases their bodies were allowed to become well coated with dried excrement; frequently little or no attention was given to the cooling of the milk; cobwebs, dust and general litter accumulated in the stables; the barnyards often became choked and muddy from the accumulation of manure. It should be noted that the failure to attend to these details saved money or saved labor, which, under present conditions, amounts to the same thing to the producer. It should also be noted that with the exception of the tuberculin test there was no single day when any one of the above conditions could have been said to have changed from good to bad. The resulting bad conditions were the cumulative result of a gradual lowering of the standard of doing business.

REASON FOR THIS CHANGE IN SANITARY CONDITIONS.

In attempting to locate the cause for this marked deteroriation in sanitary conditions it should be remembered that not a letter of the city milk ordinances has been changed, that the form of milk inspection has been continued, that the milk is still sold by the producer to the retailer under the same form of contract which was in force when advancement was most rapid. In short, every external form and legal enactment which accompanied one of the most striking recorded cases of municipal improvement of a milk supply is still in force and yet within less than two years the sanitary conditions surrounding the milk production have returned essentially to the condition in which they were at the beginning of the original improvement.

Under the sliding scale contracts as explained on page 42 the wholesale price of milk increased one-half cent per quart in passing from "medium" to "good" or from "good" to "excellent." As explained in Bulletin 337 the increased expense connected with bringing a dairy ranking as "medium" into the "good" class was ordinarily confined to that of the labor connected with keeping the cows and their surroundings cleaner and in cooling the milk. As the production of "medium" milk at 3 cents per quart was financially unprofitable and the expense attending the change to the "good" grade amounted to less than one-half cent per quart the dairies all came up to the "good" grade. In bringing the dairy up to the "excellent" grade the farmer not only incurred an increased expense for cleanliness and cooling of his milk but also faced the problem of maintaining a herd which would pass the tuberculin test. The extent of loss in connection with reacting animals was so uncertain that the majority of the farmers hesitated to take the chance even with a margin of one-half cent per quart. So far

as information is available all those who took the chance found it financially profitable.

The situation which existed during 1911 may be summarized by saying that the farmers produced fairly sanitary milk because it was the quality which they could produce most profitably.

Under conditions which existed during the latter part of 1912, when the official grading of the dairies merely retained them at the highest grade which they had previously reached, the financial stimulus for the production of cleaner milk was weakened if not entirely removed. Although the farmers exercised progressively less care in the production of milk they suffered no financial penalty. While the retailers were aware that the sanitary quality of the product as furnished them was deteriorating they could make no effectual protest since they were bound by their contracts to accept the official score as the basis for payments.

CONCLUSIONS.

The former system of wholesale prices according to which milk was bought by weight or measure regardless of its commercial quality practically compelled the production of the cheapest and dirtiest possible supply.

At present prices the margin of profit in the production of milk is so narrow that the farmers can not afford to act the part of philanthropists by the production of a higher grade of milk than the market demands and is willing to pay for.

On the other hand the farmers have a business sense which quickly leads them to produce the grade of product for which they can obtain the largest margin of profit.

The important fact which stands out clearly in the present situation is that while the farmers are able and willing to produce a sanitary milk whenever such production is the more profitable they can not be expected to continue such production whenever there is greater profit in the making of dirtier milk.

The lessons which have been taught by this five years' study of a municipal milk supply indicate fairly clearly that the farmers are prepared to produce any grade of milk which the market desires. They will produce it as soon as the market clearly states its wants and offers a price which will make the production reasonably profitable.

Under present conditions there is a demand for milk for three distinct purposes: for the feeding of infants, use by adults at table, and for cooking. The simplification of the municipal milk problem lies along the line of defining and establishing commercial grades of milk which shall correspond to these market demands.

Whenever it becomes possible to buy milk by such grades and feel sure that the milk is true to grade the supply upon the market will become just as clean and pure as the purchasing public desire it to be.

THE EFFECT OF CERTAIN DAIRY OPERATIONS UPON THE GERM CONTENT OF MILK.*

H. A. HARDING, G. L. RUEHLE, J. K. WILSON AND G. A. SMITH.

SUMMARY.

1. There is great opportunity for economy in sanitary milk production through the saving of useless labor. In order to be a guide in this matter dairy studies must be on the basis of single dairy processes.

2. The protection of milk pails from accidental contamination after they had been thoroughly steamed had a measurable effect in reducing the germ content of the milk.

3. The cleanliness of the interior of the stable, within a fairly wide range, had no measurable effect upon the milk.

4. Clipping the udder, flank and adjoining portions of the cow slightly increased the germ content of the milk when the cow was cleaned either by hand or with a vacuum cleaning machine.

5. When cows were cleaned with a brush and comb at the rate of two cows per minute the germ content of their milk was practically the same as when the same cows were treated with a vacuum cleaner at the rate of one cow per minute.

6. When all of the utensils had been carefully steamed, cooling and straining the milk resulted in only a small increase in germ content even when this was done under what would ordinarily be considered as rather unfavorable conditions.

INTRODUCTION.

When health officials, failing to find other means of characterizing sanitary milk, undertook to specify the conditions under which it should be produced they were confronted by an almost total lack of detailed information upon this subject. This lack arose from the fact that the available studies upon milk sanitation were in the nature

* Reprint of Bulletin No. 365, August, 1913; for Popular Edition, see p. 763.

of general surveys of the situation. While these general surveys were a necessary preliminary they gave little information as to either the absolute or the relative importance of any given dairy operation.

Later these official dairy regulations took the form of score cards.[1] These cards not only selected certain operations as important but assigned to each of them a definite numerical value.

This arbitrary selection of values in the absence of definite information upon the subject has frequently done injustice to the dairy business and can be justified only upon the ground of the urgent need of official action. The importance of the interests involved demands that the needed information shall be furnished as promptly as possible.

Investigations directed toward this end have been in progress at this Station for some years. The results of studies of milking machines,[2] of small-topped milking pails,[3] and of the germ content of the udders[4] have already been presented and the studies of the influence of barn air upon the germ content of the milk are in progress.

The present publication summarizes observations made upon the influence upon the milk of such operations as protecting the milk pails, plastering and otherwise renovating the interior of the cow stable, clipping the cows' udders and flanks and cleaning the cows by hand and with the vacuum cleaner. It chances that some of these operations have been found to have little or no influence upon the milk but because of the previous lack of exact information these measurements are none the less important on this account. If the dairy work of the future is to be done with the highest efficiency and at the least expense it is very important to recognize that a few operations do and that many do not effect the sanitary quality of the milk.

The accumulation of the data here recorded has extended over a period of about five years. In the experiments conducted up to August, 1910, the collection of the samples and their analysis and the keeping of the notes were entrusted to Mr. Wilson. This includes all the data presented under the headings, " Results of protecting

[1] One of the earliest dairy score cards, if not the earliest, is given in the Annual Report of the Health Officer of the District of Columbia, 25 (1903–4): 27. 1904.

[2] Harding, H. A., Wilson, J. K., and Smith, G. A. Milking Machines: Effect of method of handling on the germ content of the milk. N. Y. Agr. Exp. Station Bul. 317. 1909. Also in Smith, G. A., and Harding, H. A. Milking Machines: Effect of machine method of milking upon the milk flow. N. Y. Agr. Exp. Station Bul. 353. 1912.

[3] Harding, H. A., Wilson, J. K., and Smith, G. A. The modern milk pail. N. Y. Agr. Exp. Station Bul. 326. 1910.

[4] Harding, H. A., and Wilson, J. K. A study of the udder flora of cows. N. Y. Agr. Exp. Station Technical Bul. 27. 1913.

pails with cloth " and " Observations on methods of sampling," the figures covering the effect of plastering and painting the stable but not the test of the effect of whitewashing, and the preliminary experiment on the effect of clipping cows. During the remainder of the investigations this work was done by Mr. Ruehle. The responsibility for controlling the barn conditions during the progress of the experiments has rested upon Mr. Smith, who has personally supervised the barn and dairy operations in connection with the experimental milkings. Those most familiar with the difficulties attending this class of experimental work will undoubtedly be surprised at the accordant results extending over so many years. The secret of this uniformity in results lies largely in the success with which barn conditions were held to a definite standard during the experiments. The wide variations which so commonly occur in experiments of this nature are probably due quite as much to lack of control of important factors affecting the thing being measured as to errors in measurement. Mr. Harding assisted in planning and supervising the experimental work and in preparing the results for publication.

TECHNIQUE.

With the exception of the germs from within the udder and those introduced by the utensils and the hands of the milker all germs enter the milk through the air. The number which enter depends upon the germ content of the air and the length of time during which the milk is exposed to it. The actual exposure varies greatly under different conditions of barn management but with hand milking the time of exposure during the milking process is fairly definite, ranging between five and ten minutes. Ordinarily the longer milking periods are associated with larger yields of milk so that when the results of the exposure are expressed in germs per cubic centimeter these numbers are fairly comparable.

Unit of exposure.— Under no system of hand milking is it possible to reduce the exposure of the milk below that taking place during the milking process. Accordingly in these studies the exposure employed in measuring the influence of a given barn operation upon the germ content of the milk was that occurring during the actual milking of the cows.

It may be objected that the variation in time required to milk different cows renders this unit too variable to be satisfactory. It

was chosen as the best available unit with an appreciation of its deficiencies. It is expected that the quantitative studies of the germ content of the barn air which are now being pursued will furnish a more scientific unit for such comparisons and the results obtained by the newer method will furnish a means for checking the accuracy of the results here presented. It is believed that by using the same cows and the same milkers throughout each experimental study the objections to the unit of exposure were met with fair success.

Pail used.— The material falling from the body of the cow during the milking process furnishes a considerable part of the germs which enter the milk through the air. The study of modern milk pails[5] has shown that by their use the larger part of this contamination may be prevented, and since they have many good features with practically no unsatisfactory ones they are rapidly becoming a part of better dairy practice. Therefore, with the exception of the studies of methods of sampling which were made in connection with the milking machine, an improved Loy pail such as was fully described in Bulletin No. 326 was always used in these studies.

Cleaning of pails.— The pails were cleaned with hot water, sal-soda and a brush in the ordinary way, followed by an exposure to flowing steam in a steam box for 15 minutes.

Protection of the pails.—After being steamed the pails remained in the steam box until milking time when they were taken to the barn by one of the authors and delivered to the milker when he was prepared to begin the actual milking process. As a further protection the top of each pail was covered with a cloth before it was placed in the steam box and this cloth remained upon the pail until it was handed to the milker. The influence of this protection upon the germ content of the milk is discussed on page 61.

Sampling.— Since the importance of these barn operations is to be judged by the number of germs found in the samples of milk it is of the greatest importance that these samples shall accurately represent the true germ content of the pail of milk. The details of a study of this question of methods of sampling are given on page 55. As a result of this study the method adopted was to remove the pail of milk immediately to an adjoining milk room, stir it thoroughly with a sterile long-handled spoon and with the spoon transfer a sample to a sterile test tube.

[5] See footnote 3, p. 198.

Plating.— The samples were taken to the laboratory and the plating completed within an hour. The medium used was designated as medium 3.20 and had the following composition up to July 1, 1909, after which the sodium chloride was dropped:

Beef extract — Liebig...	5 grams	Reaction 1.5 per ct. normal acid to phenolphthalein.
Sodium chloride........	5 "	
Peptone —Witte........	10 "	
Agar....................	15 "	
Lactose, C. P..........	10 "	
Distilled water.........	1000 c.c.	

The dilutions employed ranged from 1 to 2 to 1 to 1000 depending upon the germ content of the material under examination.

Incubation and counting.— Since the germs in freshly drawn milk come partly from the udder where they have been held constantly at blood heat and partly from the barn air which is constantly at a much lower temperature, they are not adapted to incubation at a single temperature.[6] On account of this temperature relationship the plates were held five days at room temperature and two additional days at 37° C. and the count here given is that at the close of the second incubation period unless some other period of incubation is specifically mentioned. The construction of incubating chambers in which the desired lower temperatures are constantly available is described in Technical Bulletin 29[7] but these chambers were not available until after the close of these studies.

The counting was done under a hand lens magnifying four diameters. The count here recorded is the average of not less than three and frequently as many as six plates. Occasionally plates present themselves which on account both of the kinds of colonies and their number indicate that some contamination has occurred. These have been omitted from the calculations.

EXPERIMENTAL DATA.

OBSERVATIONS ON METHODS OF SAMPLING.

While there is no well established method of securing samples for bacteriological study from the milk pail it is the almost universal practice to collect such a sample in a sterile test tube as the milk is being poured from the pail.

[6] N. Y. Agr. Exp. Station Technical Bul. 27. Page 10.
[7] Conn, H. Joel, and Harding, H. A. An efficient electrical incubator. N. Y. Agr. Exp. Station Technical Bul. 29. 1913.

When studying the influence of the milking machine upon the germ content of the milk the irregularities of the results obtained from such samples led to a study of the influence of various methods of sampling. In considering the results given below it should be remembered that the milk obtained by the milking machine is much more thoroughly protected from the entrance of contaminating material than is practicable with hand milking.

The samples were collected in sterile test tubes as the milk was poured from the milking machine. Samples were collected at the

TABLE I.— BACTERIAL CONTENT OF MILK AS IT IS POURED FROM THE PAIL.

DATE.	FIRST MILK.		MIDDLE MILK.		LAST MILK.	
	No. per cc.	Rank.	No. per cc.	Rank.	No. per cc.	Rank.
1907.						
May 7......	1,983	—	2,683	0	5,217	+
8......	3,833	—	8,100	0	11,083	+
9......	3,166	0	4,733	+	3,117	—
14......	10,310	0	19,326	+	3,277	—
	58,415	+	14,533	0	13,316	—
15......	6,883	—	7,391	0	7,800	+
	13,900	+	6,008	—	8,100	0
16......	1,933	0	1,516	—	2,816	+
	2,626	0	5,053	+	650	—
17......	18,400	+	3,513	—	10,766	0
	23,850	0	15,383	—	30,116	+
	3,660	0	10,261	+	3,437	—
	8,766	0	8,127	—	16,441	+
June 7......	3,733	0	3,250	—	4,350	+
	15,583	0	14,660	—	16,800	+
	8,196	+	6,058	0	4,936	—
	14,356	+	9,333	—	9,696	0
10......	1,835	+	1,468	—	1,828	0
	6,837	+	4,182	—	5,296	0
	4,150	+	2,928	—	3,185	0
	3,293	0	2,968	—	3,441	+
11......	2,328	0	1,486	—	4,233	+
	1,283	0	745	—	1,453	+
	2,440	—	2,583	0	2,591	+
12......	2,958	0	2,453	—	3,795	+
	1,720	—	2,225	0	2,533	+
	1,680	0	1,473	—	2,595	+
	4,625	+	2,817	—	4,461	0
13......	3,728	—	4,286	+	4,107	0
	4,861	—	5,168	0	5,620	+
	2,247	0	1,946	—	4,630	+
	3,603	0	3,756	+	2,966	—
Totals.......	247,181		180,412		204,650	
Average.....	7,724		5,669		6,395	

beginning, at about the middle and at the close of the pouring process. Plates were made using medium 3.20 and the counting was done after 5 days at room temperature. The earliest plates were made with dilutions of 1 to 100, 1 to 500 and 1 to 1000 but the dilutions were soon changed to 1 to 10, 1 to 100 and 1 to 500. Six plates were made from each sample and the average of the results from all of the plates was taken as the germ content.

The germ contents of 32 sets of these comparative samples representing 32 different pails of milk and the relative rank of each sample in its own set, using + for highest, — for lowest and 0 for medium, are given in Table I.

It is seen from the above table that the average germ content is highest in the samples collected at the beginning of pouring the milk from the pail. The samples taken midway in the emptying process gave the lowest average numbers while those collected at the close of the emptying process had an average germ content midway between the other two sets of samples. These average numbers bear the same relation to each other as 100, 73 and 82. An inspection of the results from the individual sets of samples shows that these average values have little significance since there is very wide variation in the relation of the numbers found in the different sets of samples.

Since there were three samples taken from each pail of milk the germ content of each individual sample must rank as highest, lowest or medium in its set. This ranking of each sample is indicated in the above table under the heading of rank using + for highest, — for lowest and 0 for medium. These rankings of the samples in Table I are collected for better comparison in Table II.

TABLE II.— SUMMARY OF RANKINGS OF SAMPLES GIVEN IN TABLE I.

	FIRST MILK.		MIDDLE MILK.		LAST MILK.	
	No.	Per ct.	No.	Per ct.	No.	Per ct.
Highest	9	28	6	19	17	53
Medium	16	50	8	25	8	25
Lowest	7	22	18	56	7	22

The summary as given in Table II tells quite a different story from the numerical averages in Table I. From this summary it is

seen that in only about one-quarter of the sets of samples was the highest germ content found in the first sample of the set. In more than one-half of the cases the highest numbers were obtained from the last of the three samples.

TABLE III.— GERM CONTENT OF FOAM, MILK FROM CENTER OF PAIL AND WELL STIRRED MILK.

DATE.	FOAM.		CENTER OF PAIL.		STIRRED MILK.	
	No.	Rank.	No.	Rank.	No.	Rank.
1909.						
Feb. 1	1,903	+	1,346	—	1,533	0
	13,800	0	13,583	—	14,383	+
2	51,400	—	57,667	0	60,267	+
	3,187	+	2,623	—	2,653	0
4	2,277	+	2,043	0	1,933	—
	5,593	—	6,533	0	6,700	+
5	2,993	+	2,183	0	2,113	—
	22,960	0	22,493	—	24,793	+
6	1,840	0	1,860	+	1,767	—
	21,393	—	24,147	0	27,360	+
8	3,973	—	4,723	0	5,203	+
	7,257	—	8,100	+	7,483	0
March 29	2,250	—	4,850	+	3,850	0
	36,925	+	24,550	—	27,675	0
30	2,900	—	6,550	+	4,825	0
	14,775	0	14,525	—	19,850	+
31	6,475	+	1,875	—	3,900	0
	25,050	—	38,875	0	93,400	+
April 1	4,450	+	2,825	—	4,400	0
	20,450	—	20,925	0	23,350	+
2	2,567	—	4,700	0	6,275	+
	7,700	—	18,375	0	23,025	+
3	8,200	+	8,150	0	4,425	—
	30,125	—	30,350	0	30,375	+
5	3,375	—	5,675	0	10,933	+
	20,700	—	21,525	0	28,300	+
6	6,175	0	6,100	—	8,000	+
	20,133	—	29,050	0	35,225	+
7	5,050	—	10,000	+	5,325	0
	21,575	—	28,800	+	28,700	0
8	8,625	+	3,900	—	4,067	0
	15,500	—	21,300	+	21,000	0
9	6,025	0	5,950	—	7,950	+
	42,400	—	49,375	0	67,500	+
10	11,333	+	6,725	—	7,750	0
	25,075	+	23,300	—	24,950	0
Total	486,409		535,551		651,238	
Average	13,511		14,876		18,089	

It is evident from these comparisons that there is no reasonably constant relation between the germ contents of samples collected in this way; the number of germs found in any particular sample is only a general indication of the germ content actually present in the pail of milk.

A further study of the distribution of the bacteria in a pail of milk drawn freshly by the milking machine was made as follows: With a sterile long-handled spoon a sample of foam was collected, a second sample of the milk was drawn from approximately the middle of the pail with a sterile pipette and a third sample was taken after thoroughly stirring the entire pail of milk with a long-handled sterile spoon. The germ content of these samples was determined as in the preceding study except that only three plates were prepared from each sample and the dilutions used were 1 to 10, 1 to 20 and 1 to 50. The numerical results from 36 sets of samples are given in Table III.

The average numerical results from these three sets of samples are in no better accord than those recorded in Table I. These averages bear the same relation to each other as 75, 82 and 100, which are practically the same ratios as found in the preceding sets of samples.

The rankings of the various samples in the above table are summarized in Table IV.

TABLE IV.— SUMMARY OF RANKINGS OF RESULTS GIVEN IN TABLE III.

	Foam.		Center of Pail.		Stirred Milk	
	No.	Per ct.	No.	Per ct.	No.	Per ct.
Highest	11	30	7	19	18	50
Medium	6	17	16	44	14	39
Lowest	19	53	13	37	4	11

While there is no very striking agreement in the rankings of the samples as shown in this table it will be noted that 50 per ct. of the highest samples were among those taken after a thorough stirring of the pail of milk and 39 per ct. of the medium samples were also of this class. These last samples have the added advantage that they were taken under conditions which would ordinarily be considered as being

most favorable for obtaining a true sample of the milk, that is, after a thorough stirring of the contents of the pail.

In view of the favorable results obtained by stirring the milk with a sterile spoon a comparison was made between such samples and those obtained by pouring. In this case samples were collected in sterile test tubes as the milk was poured from the milking machine into sterile pails. The milk was then stirred thoroughly with a long-handled sterile spoon and a second sample collected. The technique of plating and incubation was the same as with the preceding samples.

The results from 23 such sets of samples are given in Table V.

TABLE V.— GERM CONTENT OF SAMPLES OBTAINED BY POURING AND BY SPOON.

Date.	Poured Sample.		Spoon Sample.	
	No.	Rank.	No.	Rank.
1909.				
June 21	1,780	—	1,813	+
	930	—	1,311	+
	1,171	—	1,351	+
22	10,724	—	14,800	+
	4,265	—	5,020	+
	2,686	—	2,788	+
	2,637	—	3,000	+
23	1,426	—	2,531	+
	16,076	—	20,626	+
	3,766	—	4,173	+
	1,791	+	1,511	—
24	6,423	—	18,533	+
	3,850	+	2,700	—
	3,660	—	3,840	+
	1,756	—	2,096	+
25	2,373	+	1,550	—
	708	—	1,113	+
	1,583	—	1,913	+
	2,008	+	1,461	—
26	1,726	—	2,896	+
	2,435	—	2,538	+
	1,623	—	2,556	+
	1,448	+	1,425	—
Totals	76,845		101,545	
Average	3,341		4,310	
Highest		5		18
Lowest		18		5

From the above results it is seen that the samples taken with a sterile spoon not only gave a distinctly larger average germ count

but that in practically all cases the spoon samples gave larger counts than the corresponding poured sample.

Since the thorough mixing of the milk previous to drawing a sample for bacteriological study is in entire accord with the best practice in drawing such a sample for any other purpose and since there is a noticeable tendency for such samples to show a higher bacterial content than when taken in other ways the method of collecting samples with a sterile spoon was adopted throughout this study.

It should be noted that these observations were made in connection with studies of the milking machine. Since in hand milking the distribution of the contaminated material throughout the milk is naturally more uneven than with machine milking there is here even more necessity for the exercise of care in obtaining a representative sample. Accordingly this technique which was adopted in connection with the study of the machine milking was continued in connection with the studies of hand milking.

PROTECTING THE PAILS WITH CLOTH.

The result of protecting the pails from the time they were cleaned up to the moment when they were needed by the milkers was tested as follows: Of four similar improved Loy pails which had been cleaned in the same manner, two were protected by tying cloths over their tops before they were placed in the steam box. All the pails were then steamed for 15 minutes.

The two unprotected pails were taken to the barn with the other dairy utensils while the two protected pails were left in the steam box until milking time and then were taken to the barn by one of the authors (W). The cloths were removed and the pails delivered to the milkers just as they were ready to begin the actual milking process.

Four cows were selected for this experiment and each cow was milked into a separate pail, two of the pails being those which had been protected by cloths and two unprotected. The following day the protective coverings were placed upon the alternate pairs of pails. Each cow was milked each day by the same man into the same pail and care was exercised to keep all of the other barn factors as nearly constant as possible. Under such experimental conditions it would seem that all factors were fairly balanced except the personal

characteristics of the cow, such as her udder content, nervousness and other peculiarities. This was balanced as fully as possible by milking a given cow into a protected and an unprotected pail on alternate days.

The germ content of the milk from each cow at each milking as determined under these conditions is given in Table VI.

TABLE VI.— EFFECT OF PROTECTING PAIL ON GERM CONTENT OF MILK.

DATE.	INCUBATED.		Cow.	Milker	Protected pail.	Unprotected pail.
	Days.	Temperature.				
1909.					*Per cc.*	*Per cc.*
11-17.....	6	21°C.	Ruth F.......	W	....	960
11-18.....	6	21°C.	" ".......	"	1,447	....
11-19.....	7	21°C.	" ".......	"	....	2,366
11-20.....	6	21°C.	" ".......	"	2,441	....
11-22.....	7	20°C.	" ".......	"	....	7,620
11-23.....	6	20°C.	" ".......	"	856	....
11-17.....	6	21°C.	Dollie F. No. 3	D	....	356
11-18.....	6	21°C.	" "	"	83	....
11-19.....	7	20°C.	" "	"	....	208
11-20.....	6	21°C.	" "	"	112	....
11-22.....	7	20°C.	" "	"	....	328
11-23.....	6	20°C.	" "	"	236	....
11-17.....	6	20°C.	Gertie.........	W	86	....
11-18.....	6	21°C.	"	"	....	145
11-19.....	7	21°C.	"	"	1,038	....
11-20.....	6	21°C.	"	"	....	458
11-22.....	7	20°C.	"	"	187	....
11-23.....	6	20°C.	"	"	....	396
11-17.....	6	21°C.	Ruth S........	D	1,102	....
11-18.....	6	21°C.	" "	"	....	5,783
11-19.....	7	20°C.	" "	"	contaminated.	....
11-20.....	6	21°C.	" "	"	....	6,400
11-22.....	7	20°C.	" "	"	2,552	....
11-23.....	6	20°C.	" "	"	....	4,671
Totals..........					10,140	28,691
Averages per cc..........					922	2,391

As will be seen from the above table the average germ content of the milk in pails which had been protected with a cloth was 922 per cc. while in the unprotected pails the average germ content was 2,391 per cc. This increase of 160 per ct. in the germ content due to the exposure of the pails is at least a rough indication of the need, in careful dairies, of protecting the pails after they have been satisfac-

torily cleaned. It should be noted, however, that in the above tests but a single cow was milked into each pail. The influence of this initial contamination would undoubtedly have been very much less in the case of succeeding cows milked into the same pail. On the other hand the pails in this experiment were kept under fairly clean conditions and the amount of contamination to which they were exposed was slight compared with pails in ordinary dairy practice.

In the light of these results all of the pails used in the following experiments were carefully protected with cloth up to the moment when they were desired by the milker since the aim in this work was to determine the contamination occurring during the milking process.

EFFECT OF PLASTERING AND WHITEWASHING STABLE.

One of the newer things in dairy barn construction is the finishing of the interior of the cow stable with lath and cement. This construction insures a tight ceiling and a smooth interior to which little dust can cling. It has the added advantage of a light interior, the whiteness of which can be cheaply renewed by whitewash. In new construction this finish has much to commend it since it is satisfactory from the sanitary point of view and is one of the cheapest methods of tightly ceiling up the interior.

The Station barn was constructed in 1904. The cow stable was ceiled at the top and sides with planed, beaded, matched, southern pine. This wood was finished with a coat of oil and shellac which was in accord with accepted dairy stable construction at that time. Such construction is not as highly considered at present because of the attention now given to the collection of dust in the cracks between the boards and in the depressions of the beading. The stanchions in this stable are the "Drown stalls" which were designed before attention to stanchion construction was directed toward avoidance of dust accumulation.

In order to contrast the effect of this older construction under unfavorable conditions with the newer at its best, dust was allowed to accumulate on walls, ledges and stanchions until they were in as bad a condition as would be tolerated under reasonably good barn management.

As a measure of the influence of this condition of the barn the germ content of the milk on June 6–11, 1910, was determined from six cows

at each of six milkings. These six cows were quite evenly distributed about the stable. They were milked by two men, each man using the same pail while milking his three cows and always milking the same cows in the same order. Millie F., Nora D., and Millie F. B. B. were milked by milker D. and Chloe B., Carey S. F., and Mabel S. F. by milker W. The pails and their protection, the sampling of the milk from each cow, the plating out, incubation and counting of the germs in the milk were all done in accordance with the description given under the head of Technique (page 53).

After this study of the influence of the earlier barn conditions, the ceiling and walls down to within 3 feet of the floor were covered with wire lath and two coats of cement. The area between the cement and the floor was covered with zinc.

In putting the barn in order after the plastering, the stanchions, floors and mangers were thoroughly cleaned.

As soon as the barn was in order the germ content of the milk as it was obtained from the same six cows was again examined on six days. During this second test a strong effort was made to conduct all of the operations connected with the barn management and the bacterial examination of the milk under conditions identical with those of the earlier test with the single exception that the surface of the interior of the stable had been renewed or thoroughly cleaned.

In Technical Bulletin 27[8] it was shown that the germ content of the udder could be measured fairly accurately by determining the bacterial content of the strippings. In the present study samples of the strippings were secured each day from each cow by milking a single stream from each teat into a separate sterile test tube. This was the method of sampling found satisfactory in connection with the study of the udder flora referred to above.

A composite sample was prepared for each cow by mixing together one cc. of the strippings from each teat and the germ content of this composite sample was determined in the same manner as for the samples from the milk pail. It was shown in Technical Bulletin 27 that the germ content of the milk in the back quarters of the udder was ordinarily distinctly higher than that from the front quarters. Since more milk is secreted by the back than by the front quarters a composite sample prepared as above shows a number below that of the true udder content.

[8] See footnote 4, p .198.

The test of the barn after the plastering extended from July 11 to July 18, 1910. As soon as the services of painters could be obtained the woodwork and the iron work of the stable were painted. When this had become thoroughly dry the cattle were returned to the stable and the germ content of the milk as obtained from the same cows under this new condition was again determined. This determination was made August 10–17 under the same general conditions which had accompanied the other tests.

The numerical results from these three comparative tests are given in Table VII.

A comparison of the germ content as determined in the strippings and in the milk taken from the pail at the close of the milking process shows a close relationship between the two. With Millie F. and Nora D., where the germ content of the whole milk is relatively high, the germs in the strippings are also numerous. With the remaining cows where the total germ content was lower the bacteria in the strippings were less abundant, being particularly low in numbers with Millie F. B. B. In all of these comparisons there were only two cases in which the samples from the strippings gave the larger numbers and these samples were from Mabel S. F. on July 14 and August 16. The high content of the strippings from this cow before and after these particular high counts suggests that this was not a mere error in technique but was due to some unusual udder condition. The colonies which appeared so abundantly upon the plates at this time seemed to be identical with those previously observed in connection with this udder. While the numbers found in the other udder samples are not constant from day to day they ordinarily vary within comparatively narrow limits.

Under the head "Difference" in Table VII is given the number obtained by subtracting the udder content from that of the milk in the pail. If the numbers given under this heading were an accurate measure of barn conditions all of the numbers in each column would be the same. It is manifest from an inspection of the above numbers that the individualities of the cows have affected these results. The work of two different milkers has also had an influence. In short there are a number of factors which have influenced these results which could be balanced only by keeping them as uniform as possible throughout all of the comparisons. Notwithstanding these variations in conditions the results are surprisingly

TABLE VII.— BACTERIAL CONTENT OF MILK DRAWN BEFORE AND AFTER PLASTERING AND AFTER PAINTING OF STABLE.

Before Plastering.				After Plastering.				After Painting.		
Cows.	Whole milk.	Strippings.	Difference.	Cows.	Whole milk.	Strippings.	Difference.	Whole milk.	Strippings.	Difference.
Millie F.	2,240	207	2,033	Millie F.	1,944	199	1,745	522	130	392
"	756	187	569	"	1,710	352	1,358	590	89	501
"	3,510	378	3,132	"	841	232	609	1,134	105	1,029
"	2,679	226	2,453	"	1,652	110	1,542	1,226	230	996
"	3,354	177	3,177	"	2,064	192	1,872	1,100	135	965
"	1,090	396	694	"	2,238	384	1,854	862	147	715
Nora D.	854	294	560	Nora D.	1,616	356	1,260	642	203	439
"	670	262	408	"	1,338	293	1,045	982	206	776
"	906	314	592	"	960	456	504	1,452	218	1,234
"	562	283	279	"	1,500	690	810	1,064	237	827
"	1,204	282	922	"	1,392	660	732	1,284	327	957
"	450	437	13	"	980	163	817	1,980	127	1,853
Millie F. B. B.	125	69	56	Millie F. B. B.	330	38	292	167	12	155
"	301	46	255	"	81	16	65	38	10	28
"	169	25	144	"	165	26	139	47	22	25
"	800	472	328	"	242	8	234	70	1	69
"	243	5	238	"	119	12	107	120	9	111
"	120	56	64	"	122	4	118	55	14	41
Chloe B.	476	130	346	Chloe B.	421	179	242	323	110	213
"	183	14	169	"	226	56	170	401	49	352
"	478	54	424	"	297	59	238	589	309	280
"	444	123	321	"	281	113	168	516	153	363
"	330	119	211	"	462	55	407	625	375	250
"	309	121	188	"	334	102	232	472	112	360

Carey S. F.	270	39	231	Carey S. F.	370	129	250	Contaminated.		
"	300	132	168	"	Milk	bloody.		234	97	187
"	438	68	370	"	255	69	186	266	90	176
"	856	330	526	"	477	169	308	223	62	161
"	646	122	524	"	771	52	719	426	77	349
"	296	25	271	"	921	123	798	176	58	118
Mabel S. F.	442	120	322	Mabel S. F.	1,380	366	1,014	1,060	192	868
"	418	10	408	"	1,053	151	902	693	480	213
"	786	223	563	"	974	504	470	694	558	136
"	557	404	153	"	1,063	1,188	—125	900	514	386
"	457	253	204	"	968	888	80	888	1,068	—180
"	196	58	138	"	1,546	323	1,223	1,157	398	759
Totals	27,915	6,461	21,454		31,102	8,717	24,295	22,978	6,924	16,052
Average	775	179	596		889	249	694	656	198	459

uniform. With the exception of the results from Millie F., which were slightly higher than the others, there were only 5 milkings out of 88 where this number given under the head of difference amounted to more than 1000 germs per cc.

For convenience in comparison the preceding table may be condensed to present the average germ content observed in the case of each of the cows during the three different conditions of barn management. This condensed summary of averages is given in Table VIII.

TABLE VIII.—AVERAGE GERM CONTENT OF MILK UNDER VARYING BARN CONDITIONS.

Cow.	Before Plastering.			After Plastering.			After Painting.		
	Whole milk.	Strippings.	Difference.	Whole milk.	Strippings.	Difference.	Whole milk.	Strippings.	Difference.
Millie F.	2,271	262	2,009	1,741	245	1,496	906	139	766
Nora D.	774	312	462	1,298	436	861	1,234	220	1,014
Millie F. B. B. .	293	112	181	176	17	159	83	11	72
Chloe B.	370	93	277	337	94	243	488	184	303
Carey S. F. . . .	468	119	348	561	108	452	265	77	188
Mabel S. F. . . .	475	178	298	1,164	570	594	899	535	364
General average	775	179	596	889	249	640	656	198	459

This table brings out the fact that the individuality of the cow stands out rather sharply in connection with barn studies of this class. The germ content as observed with Millie F. is high throughout these tests. It is also interesting that the counts from Millie F. B. B., her daughter, are consistently low through all of the tests.

Since on each night the first three cows were successively milked into a single pail and the last three into a second pail there is some evidence regarding the effect of this practice upon the germ content of the milk. The evidence in the present instance is exactly contradictory, since with the first pail there is a steady decrease in the germ content of the succeeding messes of milk while with the second pail the increase is almost as constant.

In summing up the results from these 212 milk samples it is most interesting to observe that they show no measurable effect from the change in barn conditions. Taking the results obtained in the dirty barn before plastering as the basis of calculation the milk obtained after the barn had been freshly plastered and cleaned showed an increase in germ content of 114 germs per cc., while later, when the woodwork and stanchions had received a coat of fresh paint, the germ content was 119 per cc. less than when the barn was at its worst. If these figures as obtained from the whole milk are corrected by the germ content observed in connection with the udder, which could not have been directly influenced by the barn conditions, the results show that plastering made the germ content of the milk worse by 44 per cc. and that painting improved it by 137 per cc.

What these results really show is that in the last two sets of tests when the barn conditions were essentially alike and unusually clean, the observed difference in germ content is much wider than the difference between the results when the barn was clean and was dirty. The gist of the whole matter is that the influence of the barn conditions upon the germ content of the milk was so slight that it was not measurable even when care was exercised to balance all of the other factors as fully as our present knowledge of germ influences will permit.

In health regulations for the production of sanitary milk there is frequently included a requirement that the cow stable shall be whitewashed at least once a year. Accordingly, in 1911, when somewhat more than a year had elapsed after the plastering of the stable, a test of the influence of whitewashing was made. These tests were similar to the preceding ones except for the following details: Four plates were prepared from each sample, two with a dilution of 1 to 2 and two with a dilution of 1 to 10, and the plates were incubated five days at room temperature and two days at 37° C. A steamed, protected pail was provided for receiving the milk from each of the three cows at each milking. Samples of this milk were collected on 20 days preceding and on 20 days following the whitewashing, the other barn conditions being kept as constant as possible. Samples for the first series were collected October 1–30, the application of paint to the woodwork and whitewash to the plaster was completed early in December and the second-series samples were collected December 18, 1911, to January 6, 1912. The samples were taken

from the pail with a sterile long-handled spoon. No samples of the strippings were collected during this test. The data thus obtained are given in Table IX.

TABLE IX.— INFLUENCE OF WHITEWASHING UPON THE GERM CONTENT OF THE MILK.

Before Whitewashing.			After Whitewashing.		
Ruth F. B. B.	Gertie F. No. 2.	Gertie F. No. 1.	Ruth F. B. B.	Gertie F. No. 2.	Gertie F. No. 1.
1,477	105	191	1,508	149	260
1,707	162	187	2,618	117	51
4,467	198	1,617	1,895	555	121
2,224	122	387	2,842	278	3,471
1,703	152	261	1,534	137	553
1,243	142	189	2,120	112	249
3,862	138	168	1,796	180	1,099
1,170	205	204	1,977	60	196
2,417	100	2,116	1,618	748	551
9,970	192	267	4,632	123	640
1,096	168	355	1,723	1,501	1,436
1,500	53	388	3,484	176	651
969	100	256	2,709	345	197
641	102	1,069	2,349	202	118
1,961	265	196	806	190	351
1,967	184	225	2,879	587	322
1,506	123	1,116	1,045	145	568
731	165	232	2,387	1,008	412
1,307	130	1,632	2,639	1,577	431
979	128	194	5,350	307	3,515
Average 2,145	147	567	2,396	425	760
General average 953			1,193		

Here again these two groups of 60 samples each produce average results that differ by only 240 germs per cc. The higher germ content was obtained after the stable had undergone a treatment which was supposed to make it a more sanitary place for the production of milk. The average results are so close that no one would be justified in using the above data to demonstrate that whitewashing stables is an unsanitary practice and calculated to increase the germ content of the milk produced within the stable. On the other hand these data offer no support for the common notion that white-

washing the stable is an important sanitary practice with a strong influence upon the quality of the milk.

In public health regulations and in dairy score cards, which have been designed to assist in the production of sanitary milk, much emphasis has been placed upon the materials and the details of construction of the stable and upon the care with which the interior has been kept free of dirt. As explained in the introduction, these regulations were formulated on the basis of very general information and in the absence of exact data covering these points. The results from the above careful measurements suggest that the importance of barn construction has been considerably overestimated and that within rather wide limits the condition of the stable exerts no measureable influence upon the germ content of the milk produced within it.

EFFECT OF CLIPPING COWS.

Clipping horses to facilitate cleaning is a practice of long standing. Certified milk producers commonly clip the cow's udder, the flank up to the hip joint and the long hairs on the tail above the switch as well as shorten the switch if it tends to get into the manure. In the absence of any previous attempts at measuring the influence of this practice the following experiments were conducted.

These tests illustrate the difficulties which are inherent in experimentation of this type. The individuality of the cow influences the results so markedly that comparisons of simultaneous results obtained from different cows have little value. On the other hand results obtained from the same cow on different days may be influenced by changes in surroundings which it is difficult to control. In many experiments these changes in the surroundings may be equalized by using the cow on alternate sides of the experiment on succeeding days and by using an equal number of cows on opposite sides of the comparison on any given day. However, in such a test as this where it is impossible to return a clipped cow to an unclipped condition for some months there is no escape from the necessity of testing a cow for a period, clipping her and then completing the comparison.

In a preliminary experiment conducted in 1909 the germ content of the milk from two cows was determined for six days. The udders

and flanks of these cows were then clipped with an ordinary power clipper and the germ content of their milk determined for six succeeding days. An effort was made to keep all of the barn operations as constant as possible during the test. The dilutions employed in making the plates were 1 to 5, 1 to 10 and 1 to 25. Six plates were made from each sample and the plates were counted after five or six days at room temperature. The results of these counts are given in Table X.

TABLE X.— GERM CONTENT BEFORE AND AFTER CLIPPING UDDER AND FLANK.

Before Clipping.			After Clipping.		
Date.	Hammond F.	Millie D.	Date.	Hammond F.	Millie D.
1909.			1909.		
Oct. 28......	217	448	Nov. 8....	....	89
" 29......	663	150	" 9....	31	....
Nov. 1......	100	417	" 10....	2,142	32
" 3......	364	126	" 11....	298	127
" 4......	71	44	" 12...	209	85
" 5......	contaminated	62	" 13....	214	89
" 6......	169	147			
Total........	1,584	1,394		2,894	422
Average.....	264	199		579	84
Grand average	231			331	

The results from this preliminary observation are not conclusive. On the basis of the grand averages it shows that clipping increased the germ content of the milk, but an inspection of the detailed results shows that a majority of these germs were obtained from Hammond F. on November 10. If this observation were omitted the balance would be in favor of clipping. On the other hand there was nothing in the plate growth from the sample of November 10 to indicate that contamination had occurred.

A more extensive test of the influence of clipping cows upon the germ content of the milk obtained from them was undertaken. Between February 29 to March 29, 1912, 22 samples were collected in the regular way from the milk of each of four cows. Four plates

were prepared from each sample using the dilutions of 1 to 2 and 1 to 10. The plates were counted after five days at room temperature and two days at 37°C. The udder, flank up to the hip joint and the tail above the brush were then clipped on each of the cows, using a power clipper. Between April 1 and May 9, 24 samples from each cow were collected and tested as in the case of the preceding samples. During this work care was exercised to carry on the barn operations in as constant a manner as possible except that on each day two of the cows were cleaned by hand and two by a vacuum cleaner as explained on page 75.

The results obtained from the samples collected under these conditions are given in Tables XI and XII.

It will be seen from Table XI that the average germ content of the 88 samples of milk from the unclipped cows was 204 per cc., that the average of a like number of samples of the strippings was 71 per cc. leaving a balance of 133 germs per cc. to be accounted for by the influence of the environment.

In Table XII the average germ content of 96 samples of milk from the same cows after they had been clipped was shown to be 320 per cc., the average from a like number of samples of strippings being 112 and the balance to be otherwise accounted for was 208 per cc.

An inspection of the results from the individual samples shows that this difference is not due to excessive numbers in a single sample as was the case in Table X but is the result of fairly constant differences between the two groups of samples. So far as these results can be taken to indicate anything they indicate that clipping cows increases the probabilities of germs finding their way into the milk during the milking process. They certainly lend no support to the prevailing idea that clipping the udder and flanks of cows is a valuable aid in the production of sanitary milk.

This outcome of the experiment was quite unforseen. However, close observation of the cows suggested the following explanation. Brushing or otherwise cleaning the normal coat of a cow removes the loose dirt from the surface and the outer portion of the hair. Dirt at the base of the hair is retained by the protecting coat. When the hair is clipped the cleaning process removes perhaps a larger proportion of the dirt, but during the succeeding milking process

TABLE XI.— GERM CONTENT OF MILK FROM UNCLIPPED COWS.

Carey S. F.			Gertie F. 1. B. B.			Millie F. B. B.			Carey S. B. B.		
Whole milk.	Strippings.	Difference.	Whole milk.	Strippings.	Difference.	Whole milk.	Strippings.	Difference.	Whole milk.	Strippings.	Difference.
34	23	11	164	88	76	200	1	199	91	26	65
91	60	31	473	163	310	62	8	54	154	3	151
18	19	—1	123	77	46	24	14	10	43	18	25
86	23	63	112	119	—7	448	68	380	83	8	75
108	129	—21	237	106	131	15	28	—13	35	15	20
163	49	114	364	45	319	97	159	—62	882	2	880
152	59	93	488	75	413	64	12	52	120	69	51
379	68	311	334	39	295	130	1,005	—875	304	31	273
258	175	83	261	162	99	145	70	75	246	247	—1
122	19	103	504	66	438	29	6	23	32	11	21
124	28	96	303	13	290	89	6	83	94	26	68
159	61	98	446	79	367	142	50	92	504	130	374
453	360	93	408	46	362	293	6	287	365	77	288
179	251	—72	424	243	181	114	22	92	178	31	147
107	37	70	113	27	86	35	11	24	65	12	53
26	21	5	192	18	174	54	4	50	38	25	13
138	136	2	102	118	—16	48	45	3	50	17	33
30	6	24	138	17	121	60	2	58	39	4	35
255	44	211	268	3	265	623	40	583	371	40	331
145	68	77	94	36	58	79	19	60	95	11	84
314	100	214	951	231	720	92	62	30	164	29	135
135	71	64	553	19	534	282	16	266	353	179	174
Total 3,476	1,807	1,669	7,052	1,790	5,262	3,125	1,654	1,471	4,806	1,011	3,295
Av'g'e 158	82	76	320	81	239	142	75	67	196	46	150

Grand average: Whole milk, 204; strippings, 71; difference, 133.

TABLE XII.— GERM CONTENT OF MILK FROM CLIPPED COWS.

Carey S. F.			Gertie F. 1. B. B.			Millie F. B. B.			Carey S. B. B.		
Whole milk.	Strippings.	Difference.	Whole milk.	Strippings.	Difference.	Whole milk.	Strippings.	Difference.	Whole milk.	Strippings.	Difference.
257	27	230	189	23	166	56	22	34	59	39	20
416	345	71	331	64	267	37	1	36	153	5	148
24	28	—4	238	26	212	28	16	12	73	36	37
215	278	—63	1,537	294	1,243	316	2	314	94	12	82
197	43	154	339	40	299	114	12	102	448	105	343
64	20	44	228	46	182	52	26	26	182	6	176
137	142	—5	287	67	220	39	26	13	253	59	194
207	20	187	93	26	67	87	15	72	148	23	125
658	237	421	642	76	566	269	27	242	559	66	493
351	9	342	1,386	66	1,320	49	51	—2	199	92	107
209	78	131	392	385	7	148	78	70	103	56	47
591	588	3	[416	105	811	84	64	20	196	446	—250
198	289	—91	234	9	225	165	68	97	88	30	58
127	29	98	212	19	193	52	40	12	88	8	80
227	86	141	228	28	200	303	47	256	207	75	132
755	80	675	351	84	267	235	79	156	210	53	157
102	76	26	1,122	276	846	361	144	217	277	26	251
301	391	—90	1,006	37	969	49	8	41	1,383	81	1,302
104	39	65	394	172	222	292	113	179	346	21	325
91	96	—5	428	35	393	2,388	43	2,345	816	1,570	—754
136	124	12	323	99	224	56	18	38	401	213	188
188	176	12	374	48	326	898	649	249	373	91	282
327	250	77	347	142	205	127	169	—42	254	126	128
158	24	134	182	47	135	85	44	41	232	80	152
Total 6,040	3,475	2,565	11,279	2,214	9,065	6,290	1,762	4,528	7,142	3,319	3,823
Av'g'e, 252	145	107	470	92	378	261	73	188	298	138	160

Grand average: Whole milk, 320; strippings, 112; difference, 208.

there is little protective covering to retain the dirt and bits of dead skin which are constantly breaking loose. They accordingly fall into the milk carrying their quota of germs.

HAND AND MACHINE CLEANING OF COWS.

The removal of dirt by the vacuum process is one of the newer ideas regarding sanitation which has been successfully applied in the household and in many departments of business. Since the milking machine (See Bulletin 317) provides the vacuum pump and necessary connection in the stable it is quite natural that a vacuum cleaning apparatus, adapted to the cleaning of cows, should be developed. Such a machine is in actual use in a number of dairies and in the "Methods and Standards for the Production and Distribution of Certified Milk"[9] as adopted by the American Association of Medical Milk Commissions in 1912, Section 14, under the heading of Hygiene of the Dairy, reads as follows: "*Cleaning of cows.* Each cow in the herd shall be groomed daily, and no manure, mud, or filth shall be allowed to remain upon her during milking; for cleaning, a vacuum apparatus is recommended."

So far as the authors are aware there is but one vacuum cow cleaner[10] on the market and this consists of a 40-quart can provided with a hose connection on the cover by means of which it may be connected with the vacuum pump. A cloth bag is fastened to the under side of the can cover and a hose connection at the side of the can permits the attachment of the tool to be applied to the coat of the cow. This tool is a modified form of curry comb so arranged that when the vacuum is applied the dirt is removed from the coat of the cow and collected in the bottom of the can.

After this machine had been in the barn for some months and the men had become familiar with its use, its effect upon the germ content of the milk was compared with that of ordinary hand cleaning. Four cows were employed in this test and since the vacuum cleaner is ordinarily employed in certified dairies where the cows are clipped, the udders, flanks and surrounding parts of these cows were clipped. Each day two cows were cleaned by machine and two by hand, each cow being cleaned by machine and by hand

[9] Methods and standards for the production and distribution of "certified milk". U. S. Public Health and Marine-Hospital Service. Reprint 85. 1912.
[10] Manfg. by D. H. Burrell & Co., Little Falls, N. Y.

alternately. After cleaning, the cows were so tied that they could not lie down before being milked. The machine cleaning was done under a vacuum usually slightly under 15 inches, or one-half an atmosphere, while the hand cleaning was done with a brush and curry comb, no water or damp cloth being used. The average time consumed in cleaning a cow was approximately 66 seconds with the machine and 33 seconds by hand.

The pails and their protection, the sampling and the examination of the samples were all in accord with the description given under the head of Technique (page 53). Four plates were made using dilutions of 1 to 2 and 1 to 10.

The first test was made during October, 1911, and included 88 samples of milk. The germ counts obtained from these samples are given in Table XIII.

TABLE XIII.— BACTERIA IN MILK FROM COWS CLEANED BY HAND OR BY VACUUM CLEANER.

Hand Cleaned.					Machine Cleaned.				
Date.	Ruth F. B. B.	Gertie F. 2.	Dolly F. B. B.	Gertie F. 1.	Date.	Ruth F. B. B.	Gertie F. 2.	Dolly F. B. B.	Gertie F. 1.
10-1-11..	......	......	355	160	10-1-11	979	128	......	......
10-2.....	1,307	130	......	......	10-2...	......	......	1,321	192
10-4.....	......	......	114	194	10-4...	731	165	......	......
10-5.....	1,506	123	......	......	10-5...	......	......	2,228	1,632
10-7.....	......	......	631	232	10-7...	1,967	184	......	......
10-8.....	1,961	265	......	......	10-8...	......	......	1,505	1,116
10-9.....	......	......	295	225	10-9...	641	102	......	......
10-10....	969	100	......	......	10-10..	......	......	93	196
10-11....	......	......	318	1,069	10-11..	1,500	53	......	......
10-12....	1,096	168	......	......	10-12..	......	......	116	256
10-14....	......	......	......	......	10-14..	9,970	192	193	388
10-15....	2,417	100	......	......	10-15..	......	......	4,687	355
10-16....	......	......	145	267	10-16..	1,170	205	......	......
10-17....	3,862	138	......	......	10-17..	......	......	141	2,116
10-18....	......	......	104	204	10-18..	1,243	142	......	......
10-19....	1,703	152	......	......	10-19..	......	......	456	168
10-21....	......	......	174	189	10-21..	2,224	122	......	......
10-24....	4,467	198	......	......	10-24..	......	......	467	261
10-25....	......	......	217	387	10-25..	1,707	162	......	......
10-28....	1,477	105	......	......	10-28..	......	......	5,100	1,617
10-29....	......	......	125	191	10-29..	1,781	82	......	......
10-30....	......	......	63	187	10-30..	2,346	87	......	......
Total....	20,765	1,479	2,541	3,305	......	26,259	1,624	16,307	8,297
Average..	2,077	148	231	300	......	2,188	135	1,482	754
Grand average....		689					1,140		

It is seen from the above table that the results from Gertie F. No. 2 are extremely low on both sides of the comparison and that

the numbers in both cases are practically the same. In the case of the other three cows the numbers obtained after the machine cleaning are higher than after hand cleaning and the grand averages are 689 and 1140 per cc. respectively. This shows an increase of 65 per ct. in the germ content of the milk after machine cleaning as compared with that after hand cleaning.

A second comparison of the effect of hand and machine cleaning was made between December 8, 1911, and January 6, 1912, and 96 samples of milk were examined. The conditions of the experiment were practically identical with those of the preceding one except that in the interval the stable had been freshly whitewashed and painted. The germ counts from these samples are given in Table XIV.

TABLE XIV.— BACTERIA IN MILK FROM COWS CLEANED BY HAND OR BY VACUUM CLEANER.

DATE.	HAND CLEANED.				MACHINE CLEANED.			
	Ruth F. B. B.	Gertie F. 2.	Ham. F. 1.	Gertie F. 1.	Ruth F. B. B.	Gertie F. 2.	Ham. F. 1.	Gertie F. 1.
12-8-11	......	......	1,731	8,348	2,574	1,022	......	......
12-9-11	2,502	1,081	......	......	......	......	1,692	2,956
12-11	......	......	935	891	3,990	1,025	......	......
12-12	7,795	1,593	......	......	......	......	4,715	4,203
12-13	......	......	521	3,515	5,350	307	......	......
12-14	2,639	1,577	......	......	......	......	2,891	431
12-15	......	......	604	412	2,387	1,008	......	......
12-16	1,045	145	......	......	......	......	260	568
12-18	......	......	1,337	322	2,879	587	......	......
12-19	806	190	......	......	......	......	626	351
12-20	......	......	1,045	118	2,349	202	......	......
12-21	2,709	345	......	......	......	......	914	197
12-22	......	......	686	651	3,484	176	......	......
12-23	1,723	1,501	......	......	......	......	2,506	1,436
12-26	......	......	1,347	640	4,632	123	......	......
12-27	1,618	748	......	......	......	......	803	551
12-28	......	......	351	196	1,977	60	......	......
12-29	1,796	180	......	......	......	......	7,600	1,099
12-30	......	......	106	249	2,120	112	......	......
1-2-1912	1,534	137	......	......	......	......	1,236	553
1-3	......	......	1,202	3,471	2,842	278	......	......
1-4	1,895	555	......	......	......	......	348	121
1-5	......	......	305	51	2,618	117	......	......
1-6	1,508	149	......	......	......	......	639	260
Total	27,570	8,201	10,170	18,864	37,202	5,017	24,290	12,726
Average	2,297	683	847	1,572	3,100	418	2,024	1,060
Grand average	1,340				1,650			

Here the results from Gertie F. No. 2 and Gertie F. No. 1 are in favor of machine cleaning. In the case of the two other

TABLE XV.— BACTERIA IN MILK FROM COWS CLEANED BY HAND AND BY VACUUM CLEANER.

Date.	Hand Cleaned											
	Gertie F. 2.			Ruth F. B. B.			Gertie F. 1			Ham. F. 1.		
	Whole milk.	Strippings.	Difference.	Whole milk.	Strippings.	Difference.	Whole milk.	Strippings.	Difference.	Whole milk.	Strippings.	Difference.
1-8-12..	......	......	......	......	......	......	261	37	224	1,785	307	1,478
1-11....	115	4	111	260	70	190	......	......	......	......	......	......
1-12....	......	......	......	......	......	......	214	97	117	94	74	20
1-13....	22	42	—20	2,306	193	2,113	......	......	......	......	......	......
1-15....	......	......	......	......	......	......	322	160	162	641	222	419
1-16....	66	7	59	722	1,451	—729	......	......	......	......	......	......
1-17....	......	......	......	......	......	......	206	58	148	241	58	183
1-18....	249	27	222	3,377	146	3,231	......	......	......	......	......	......
1-19....	......	......	......	......	......	......	780	390	390	702	233	469
1-20....	24	13	11	91	58	33	......	......	......	......	......	......
1-25....	......	......	......	......	......	......	7,683	7,430	253	2,370	567	1,803
1-26....	39	8	31	2,251	173	2,078	......	......	......	......	......	......
1-27....	......	......	......	......	......	......	131	33	98	1,189	431	758
1-29....	28	7	21	877	45	832	......	......	......	......	......	......
2-1....	......	......	......	......	......	......	1,469	1,698	—229	350	95	255
2-2....	118	43	75	1,586	11	1,575	......	......	......	......	......	......
Total...	661	151	510	11,470	2,147	9,323	11,066	9,903	1,163	7,372	1,987	5,385
Av.....	83	19	64	1,434	268	1,165	1,383	1,238	145	922	248	673

Grand average: Whole milk, 955; strippings, 443; difference, 512.

cows the balance is strongly in favor of hand cleaning and the grand averages are 1,340 per cc. for hand and 1,650 per cc. for machine cleaning or a balance of 23 per ct. in favor of hand cleaning of cows.

A third comparison of the influence of hand and machine cleaning was made between January 8, and February 2, 1912. The same cows were used as in the preceding experiment and they were freshly clipped as at the beginning of the other comparisons. The 62 samples of whole milk were collected and the germ content determined in the same way as in the preceding experiment. In addition 62 samples of the strippings were collected and examined.

It had been observed that while the capacity of the air pump was sufficient for the milking machine it was not sufficient to maintain a vacuum of 15 inches at all times with the vacuum cleaner. Accordingly on January 25, 1912, a smaller pulley was placed upon the vacuum pump which increased its capacity sufficiently so that after that date a vacuum of approximately 15 inches was maintained.

The results from the 124 samples are given in Table XV.

TABLE XV—(*continued*).

MACHINE CLEANED.
(VACUUM BETTER MAINTAINED).

DATE.	GERTIE F. 2.			RUTH F. B. B.			GERTIE F. 1.			SAM. F. 1.		
	Whole milk.	Strippings.	Difference.	Whole milk.	Strippings.	Difference.	Whole milk.	Strippings.	Difference.	Whole milk.	Strippings.	Difference.
1-8-12..	60	19	41	1,117	165	952	......	......	......	......	......	......
1-11..	......	......	......	......	......	......	298	113	185	1,764	568	1,196
1-12...	71	39	32	2,255	103	2,152	......	......	......	......	......	......
1-13...	......	......	......	......	......	......	296	132	164	478	38	440
1-15...	155	40	115	1,041	19	1,022	......	......	......	......	......	......
1-16..	......	......	......	......	......	......	3,729	1,457	2,272	1,960	437	1,523
1-17...	49	98	—49	3,354	404	2,950	......	......	......	......	......	......
1-18...	......	......	......	......	......	......	278	101	177	1,494	162	1,332
1-19...	227	67	160	815	61	754	......	......	......	......	......	......
1-20..	......	......	......	......	......	......	247	73	174	910	152	758
1-25...	61	39	22	2,501	512	1,989	......	......	......	......	......	......
1-26...	......	......	......	......	......	......	124	95	29	297	58	239
1-27....	20	30	—10	662	24	638	......	......	......	......	......	......
1-29...	......	......	......	......	......	......	......	......	......	1,604	678	926
2-1....	1,605	1,510	95	......	......	......	......	......	......	......	......	......
2-2....	......	......	......	......	......	......	810	51	759	608	401	207
Total...	2,248	1,842	406	11,745	1,288	10,457	5,782	2,022	3,760	9,115	2,494	6,621
Av....	281	230	51	1,678	184	1,494	826	289	537	1,139	312	828

Grand average: Whole milk, 981; strippings, 254; difference, 727.

If consideration is given to the returns from the samples of whole milk the results are favorable to machine cleaning in the case of Gertie F. 1 and to hand cleaning in the case of the three other cows. If the germs in the strippings are deducted the results are favorable to hand cleaning in the case of Gertie F. 2 and to hand cleaning in the other three cases. The grand averages of the 62 samples of whole milk are 955 after hand and 981 after machine cleaning but if the strippings are deducted these averages stand at 512 and 727 indicating an increase due to machine cleaning of 36 per ct.

In the three preceding comparisons the cows were carefully clipped at the beginning of each comparison as it was desired to conduct this test of the vacuum cleaner under the general conditions under which it was being used in dairies. A fourth comparison was made between February 29 and March 28, 1912, using four cows which had not been clipped but the other conditions were the same as those of the preceding comparison. The results obtained from the

examination of the 99 samples of whole milk and 99 samples of strippings are given in Table XVI.

TABLE XVI.— BACTERIA IN MILK FROM UNCLIPPED COWS CLEANED BY HAND OR BY VACUUM CLEANER.

DATE.	HAND CLEANED.											
	CAREY S. F.			GERTIE F. 1. B. B.			MILLIE F. B. B.			CAREY S. B. B.		
	Whole milk.	Strippings.	Difference.	Whole milk.	Strippings.	Difference.	Whole milk.	Strippings.	Difference.	Whole milk.	Strippings.	Difference.
2-29	268	76	192	377	73	304						
3-1										135	8	127
3-2	94	102	—8	376	134	242						
3-4							200	1	199	91	26	65
3-5	91	60	31	473	163	310						
3-6							24	14	10	43	18	25
3-7	86	23	63	112	119	—7						
3-8							15	28	—13	35	15	20
3-9	163	49	114	364	45	319						
3-11							64	12	52	120	69	51
3-12	379	68	311	334	39	295						
3-13							145	70	75	246	247	—1
3-14	122	19	103	504	66	438						
3-15							89	6	83	94	26	68
3-16	159	61	98	446	79	367						
3-18							293	6	287	365	77	288
3-19	179	251	—72	424	243	181						
3-20							35	11	24	65	12	53
3-21	26	21	5	192	18	174						
3-22							48	45	3	50	17	33
3-23	30	6	24	138	17	121						
3-25							623	40	583	371	40	331
3-26	145	68	77	94	36	58						
3-27							92	62	30	164	29	135
3-28	135	71	64	553	19	534						
Total	1,877	875	1,002	4,387	1,051	3,336	1,628	295	1,333	1,779	584	1,195
Av.	144	67	77	337	81	257	148	27	121	148	49	100

Grand average: Whole milk, 197; strippings, 57; difference, 140.

In the above table the average results from two of the four cows are in favor of each of the methods of cleaning and the variations in the results under the two methods of cleaning are practically the same for each cow. These results are so close that the grand averages of the germ content of the whole milk give a balance of 13 germs per cc. in favor of hand cleaning and when the germs in the strippings are deducted the balance becomes 9 per cc. in favor of machine cleaning. Closer agreement than this could hardly be expected in such experimental results.

A fifth comparison of hand and machine cleaning was made using the same cows as in the fourth comparison and keeping all of the

TABLE XVI—(*continued*).

DATE.	MACHINE CLEANED.											
	CAREY S. F.			GERTIE F. 1 B. B.			MILLIE F. B. B.			CAREY S. B. B.		
	Whole milk.	Strippings.	Difference.	Whole milk.	Strippings.	Difference.	Whole milk.	Strippings.	Difference.	Whole milk.	Strippings.	Difference.
2-29							25	0	25	97	10	87
3-1	261	32	229	401	47	354						
3-2							47	6	41	41	7	34
3-4	34	23	11	164	88	76						
3-5							62	8	54	154	3	151
3-6	18	19	—1	123	77	46						
3-7							448	68	380	83	8	75
3-8	108	129	—21	237	106	131						
3-9							97	159	—62	882	2	880
3-11	152	59	93	488	75	413						
3-12							130	1,005	—875	304	31	273
3-13	258	175	83	261	162	99						
3-14							29	6	23	32	11	21
3-15	124	28	96	303	13	290						
3-16							142	50	92	504	130	374
3-18	453	360	93	408	46	362						
3-19							114	22	92	178	31	147
3-20	107	37	70	113	27	86						
3-21							54	4	50	38	25	13
3-22	138	136	2	102	118	—16						
3-23							60	2	58	39	4	35
3-25	255	44	211	268	3	265						
3-26							79	19	60	95	11	84
3-27	314	100	214	951	231	720						
3-28							282	16	266	353	179	174
Total	2,222	1,142	1,080	3,819	993	2,826	1,569	1,365	204	2,800	452	2,348
Av.	185	95	90	318	83	236	121	105	16	215	35	181

Grand average: Whole milk, 210; strippings, 79; difference, 131.

conditions the same as before except that the cows were carefully clipped on the udder, flank, and adjoining portions. This comparison was made April 1 to May 9, 1912, and the results from the 96 samples of whole milk and a like number of samples of strippings are given in Table XVII.

Here again the results from two cows favor each method of cleaning if the results from the whole milk are considered while three are in favor of hand cleaning if the comparison is based upon the results after the germs in the strippings have been deducted. The grand averages of the germs from the whole milk give a balance

TABLE XVII.—BACTERIA IN MILK FROM COWS CLEANED BY HAND OR BY VACUUM CLEANER.

DATE.	HAND CLEANED.											
	CAREY S. F.			GERTIE F. 1 B. B.			MILLIE F. B. B.			CAREY S. B. B.		
	Whole milk.	Strippings.	Difference.	Whole milk.	Strippings.	Difference.	Whole milk.	Strippings.	Difference.	Whole milk.	Strippings.	Difference.
1912												
Apr. 1..	416	345	71	331	64	267	......	......	......	......	......	......
2..	......	......	......	......	......	......	56	22	34	59	39	20
4..	24	28	—4	238	26	212	......	......	......	......	......	......
5..	......	......	......	......	......	......	316	2	314	94	12	82
6..	197	43	154	339	40	299	......	......	......	......	......	......
8..	......	......	......	......	......	......	52	26	26	182	6	176
9..	137	142	—5	287	67	220	......	......	......	......	......	......
10.	......	......	......	......	......	......	87	15	72	148	23	125
11.	658	237	421	642	76	566	......	......	......	......	......	......
12.	......	......	......	......	......	......	49	51	—2	199	92	107
15.	209	78	131	392	385	7	......	......	......	......	......	......
16.	......	......	......	......	......	......	84	64	20	196	446	—250
17.	198	289	—91	234	9	225	......	......	......	......	......	......
18.	......	......	......	......	......	......	52	40	12	88	8	80
19.	227	86	141	228	28	200	......	......	......	......	......	......
22.	......	......	......	......	......	......	235	79	156	210	53	157
23.	102	76	26	1,122	276	846	......	......	......	......	......	......
24.	......	......	......	......	......	......	49	8	41	1,383	81	1,302
25.	104	39	65	394	172	222	......	......	......	......	......	......
26.	......	......	......	......	......	......	2,388	43	2,345	816	1,570	—754
May 6..	136	124	12	323	99	224	......	......	......	......	......	......
7..	......	......	......	......	......	......	898	649	249	373	91	282
8..	327	250	77	347	142	205	......	......	......	......	......	......
9..	......	......	......	......	......	......	85	44	41	232	80	152
Total...	2,735	1,737	998	4,877	1,384	3,493	4,351	1,043	3,308	3,980	2,501	1.479
Av.....	228	145	83	406	115	291	363	87	276	332	208	123
Grand average: Whole milk, 332; strippings, 139; difference, 193.												

of 23 germs per cc. in favor of machine cleaning and when the germs in the strippings are deducted the balance is 30 per cc. in favor of hand cleaning.

These somewhat extended observations indicate that where the vacuum is allowed to fall noticeably below 15 inches the results from machine cleaning are less satisfactory than ordinary hand cleaning. On the other hand when the vacuum in the cleaner is held at approximately one-half an atmosphere, machine cleaning is practically of the same efficiency as hand cleaning. Since the time consumed by machine cleaning was almost twice that required for cleaning by hand when the efficiency of the two processes was equal, these data suggest that, in its present stage of development, the

TABLE XVII—(*continued*).

Date.	Machine Cleaned.											
	Carey S. F.			Gertie F. 1 B. B.			Millie F. B. B.			Carey S. B. B.		
	Whole milk.	Strippings.	Difference.	Whole milk.	Strippings.	Difference.	Whole milk.	Strippings.	Difference.	Whole milk.	Strippings.	Difference.
1912												
Apr. 1							37	1	36	153	5	148
2	257	27	230	189	23	166						
4							28	16	12	73	36	37
5	215	278	—63	1,537	294	1,243						
6							114	12	102	448	105	343
8	64	20	44	228	46	182						
9							39	26	13	253	59	194
10	207	20	187	93	26	67						
11							269	27	242	559	66	493
12	351	9	342	1,386	66	1,320						
15							148	78	70	103	56	47
16	591	588	3	416	105	311						
17							165	68	97	88	30	58
18	127	29	98	212	19	193						
19							303	47	256	207	75	132
22	755	80	675	351	84	267						
23							361	144	217	277	26	251
24	301	391	—90	1,006	37	969						
25							292	113	179	346	21	325
26	91	96	—5	428	35	393						
May 6							56	18	38	401	213	188
7	188	176	12	374	48	326						
8							127	169	—42	254	126	128
9	158	24	134	182	47	135						
Total	3,305	1,738	1,567	6,402	830	5,572	1,939	719	1,220	3,162	818	2,344
Av.	275	145	131	534	69	464	162	60	102	264	68	195

Grand average: Whole milk, 309; strippings, 86; difference, 223.

vacuum cleaning of cows is not desirable from a financial point of view.

SOURCES OF CONTAMINATION IN MILK.

The low germ content of the milk at the close of the milking process and the lack of any measurable influence of the stable upon the germ content, raised the question as to what are the important sources of bacteria in milk.

Accordingly the germ content of a pail of milk was followed on 17 days from the cow through the various operations in preparing it for the consumer. In the Station dairy the milk is taken to a small milk room, separated from the stable by a single door, poured over a conical cooler which is filled with cold water, collected in a second pail and taken in this to the dairy. Here it is passed through

a cloth strainer into a third pail in which it is placed in cold water until needed.

All these utensils were cleaned with hot water and sal-soda and treated for 10 to 15 minutes in a steam box. The cooler was not protected in any special manner during use, though the milk room was kept moderately clean.

Samples of the strippings were collected directly from the udder into sterile tubes and samples were caught in like manner as the milk ran off the cooler. The samples from the pails were obtained with sterile spoons after thorough stirring. Samples were taken representing the strippings, the whole milk in the pail, the milk leaving the cooler, the milk arriving at the dairy and after it had been strained into the final can.

The technique of handling the samples was that already described and the germ counts as obtained on the 17 different days are given in Table XVIII.

TABLE XVIII.— EFFECT OF HANDLING ON GERM CONTENT OF MILK.

DATE.	Strippings.	Pail.	Cooler.	Can.	Strainer.
1912.					
1-10	170	38	60	30	38
1-11	3	23	138	187	202
1-12	30	35	75	122	99
1-13	80	34	317	84	208
1-15	40	164	127	263	114
1-16	27	53	110	161	180
1-17	69	190	72	68	96
1-18	40	205	77	135	179
1-19	21	104	153	159	218
1-20	45	31	47	38	35
1-25	24	187	171	150	282
1-26	64	165	220	294	260
1-27	7	19	51	43	38
1-29	22	422	1,172	760	1,048
1-30	62	254	342	285	266
1-31	72	301	3,635	4,290	4,362
2-1	195	504	482	463	445
Total	971	2,729	7,249	7,532	8,070
Average	57	161	426	443	474

The striking feature of the above table is the small increase in germ content in connection with the progress of the milk through the various stages of its handling. With the exception of January 29 and 31 the germ content of the milk was practically unchanged in spite of the handling which it received. On these days it evidently suffered some slight contamination during cooling, but even then it had a germ content which was surprisingly low.

It would be naturally inferred from these results that this was an attempt to ascertain the completeness with which contamination could be eliminated during such processes. Nothing could be farther from the facts. During this study the attempt was made to conduct the dairy operations in the ordinary way, and to further insure that this should be the case care was exercised that the dairy workers should not be aware that such a test was being made. To facilitate following the samples through without exciting comment, the actual milking was done by the Dairy Expert and the Bacteriologist, using pails which had been carefully steamed and protected as in the other experimental work. The smallness of the germ count was largely due to the fact that the milk was all furnished by one cow which had a rather low udder content.

CONCLUSIONS.

Those who have followed recent discussions of germ content of city milk and particularly those who are familiar with the extreme precautions which are taken by many of the producers of certified milk will be struck by the small germ content which has characterized the milk obtained during these experiments.

It is not the intention at this time to raise the question as to what is the proper standard of milk quality, but there is no question but that in the public mind the germ content of the milk is commonly used as such a standard. In public discussions of clean milk, the certified milk standard of 10,000 germs per cc. is ordinarily taken as insuring a milk which is above suspicion of uncleanliness.

In obtaining milk which shall be safely below this 10,000 limit, it is the custom to expend much labor in washing the cows and in keeping the interior of the barn scrupulously clean.

Those who have carefully noted the germ counts obtained from the milk samples as given in this publication, will be surprised at the large number of the counts which are under 1,000 germs per cc.

From the results of an extended study of the udder content of this same group of cows, it was concluded that the udder content was responsible for an average count of about 500 per cc. When allowance is made for this udder factor it will be seen that there is only a small germ count in the milk remaining to be accounted for as contamination from the outside of the cow and the barn air.

Since these counts were practically all made of the milk at the close of the milking process and the germ counts with which the public are familiar are those of the milk as ready for the market, it may be assumed that the after handling would bring the germ content of this milk up to much higher figures. The results on page 230, from the 85 samples taken at various stages in its later handling do not support this idea.

Low counts in milk studies are frequently due to the technique employed in their determination. In the present work the technique has been given in detail. The possibility of the influence of accidents in media making are fairly eliminated, since the low counts are distributed through a study lasting a number of years. On a number of occasions the possible inhibitory influence of the media was tested by using media prepared at the same time in determining the germ content of these experimental samples and of samples of milk obtained from other sources. In all cases the counts from the milk from commercial sources were high while the experimental samples remained low.

There seems to be no escape from the conclusion that the germ count of these samples was low, simply because the samples did not contain many germs which were capable of growing in the media ordinarily employed in such studies even when unusual care was exercised in stimulating their growth.

This milk was produced under general conditions which appear to be no better than those surrounding a considerable number of the ordinary city dairies, conditions which probably would not be acceptable to any certified milk commission. Notwithstanding these facts the extended study of the product indicates that in bacterial content at least it is of the very highest quality. That milk of this quality is not uniformly produced under such general conditions is illustrated by the fact that a local commercial dairy in which the methods and equipment resemble that at the Experiment Station, except that steam is not available for treating the utensils

quite uniformly turns out a product with a content approximating 1,000,000 germs per cc.

Under such circumstances it is pertinent to inquire as to the points of difference between these two dairies. At the Experiment Station, the stable is kept cleaner, the cows are much cleaner, the milkers are cleaner and the utensils are thoroughly steamed. Apparently the wide difference in the germ content of the product from these two dairies lies in the influence of one or more of these factors.

The important fact which is being gradually recognized through these and similar observations is that the production of a reasonably clean and low germ content milk will be a far simpler and less expensive undertaking when the factors which really govern its production are actually understood.

A STUDY OF THE UDDER FLORA OF COWS.*

H. A. HARDING AND J. K. WILSON.

SUMMARY.

(1) An examination of 1230 samples of milk direct from the udders of 78 cows indicates that the germ content is smaller than has previously been assumed, the average of these samples being 428 per cc.

(2) The bacteria were not evenly distributed among the quarters of the udder, there being about three times as many per cc. in the back as in the front quarters. The factor controlling this distribution has not been found.

(3) Neither the age of the cow nor the period of lactation exerted any marked influence upon the germ content of the udder.

(4) When classified in accordance with the system of the Society of American Bacteriologists the organisms found in about 900 samples fell into 71 groups. The udder flora is characterized by a lack of motility, of spore formation and of gas formation. It is largely composed of micrococci and is practically all Gram positive.

INTRODUCTION.

Bacteria exist in varying numbers in the udders of all cows. Therefore even extreme cleanliness in the dairy will not reduce the germ content of the milk below the number which it contains while it is yet within the udder. The finding by Hastings and Hoffmann[1] of an apparently healthy cow with an average udder content of 191,000 germs per cc., while an extreme case, shows the possible magnitude of this phase of the milk question. With

[1] Hastings, E. G., and Hoffmann, C. Bacterial content of the milk of individual animals. Wis. Agr. Exp. Sta. Research Bul. 6. 1909. Also in Ann. Rpts. of same Station 25 & 26 (1908–1909):189–196. 1910.

* Reprint of Technical Bulletin No. 27, March, 1913.

the increasing emphasis which is being laid upon the germ content of milk the germs in the cow's udder are becoming more and more an important factor. They are especially important in the production of "certified" milk, and the small number of germs found in the product of some "certified" dairies is made possible by the selection of cows having few germs in their udders.

The problem of producing milk with a low germ content at a moderate cost is being studied at this Station. While the presence of bacteria in the udders of healthy cows has been recognized for some time there is very little information regarding the normal flora of udders and less regarding the forces which regulate the growth of the forms which are present. A beginning has been made on this phase of the subject by examining 1,274 samples of milk representing 83 cows. A continuation of these studies along a number of lines which have as yet been hardly touched is much to be desired. The removal of each of the authors to other institutions makes necessary the publication of the results thus far obtained even though the entire field has not been covered.

ACKNOWLEDGMENTS.

The careful collection of this large number of milk samples would have been much more difficult but for the active cooperation of our colleague, Mr. G. A. Smith, and the men in his department who willingly placed all the facilities of the barn and the dairy at our disposal and actively assisted in the work.

The kindness of Mr. A. G. Lewis in assisting us to obtain udder samples from a large number of cows, many of them recently imported from the Island of Guernsey, materially broadened the investigation.

Acknowledgment should also be made of the suggestions and aid given by Dr. R. S. Breed, while he was engaged in a study of the cellular elements in the milk of many of the same cows whose udder flora was being determined.

PREVIOUS STUDIES.

Many workers have contributed to our knowledge of this subject and it will serve the present purpose to indicate merely the steps by which this knowledge has progressed.

In 1877 Lister[2] presented a paper to the Pathological Society at London which contained the following statements: "In this case, the experiment was more rigorously conducted, and here, in the majority of the glasses, at first sight, you will suppose that no change at all had occurred; and in two of them I found, at the end of six weeks, that there was no indication whatever of any organisms. I topped one of them and found the milk still perfectly fluid, of normal taste and reaction and without any organisms in it; showing that unboiled milk, as coming from the healthy cow, really has no ferment in it capable of leading to lactic fermentation or any other fermentation, or to any organic development whatever." Thus on the basis mainly of two small samples, only one of which was critically examined, there was founded the theory that the milk within the healthy udder is germ free. This theory was generally held until about 1890.

Apparently the first quantitative study of bacteria in the udder was made under the direction of Dr. Lehmann. One of his students, Schulz,[3] found that the first milk contained large numbers of bacteria while samples drawn midway and at the close of the milking process contained progressively smaller numbers of germs. The results of this study were also presented by Lehmann (17th Versammlung d. deut. Ver. f. offentl. Gesundheitspflege, Leipsic, Sept. 1891), as the work of Schulz, after they had been published as an Inaugural Dissertation by Schulz in July, 1891. These two presentations have been confused in literature and have been frequently referred to as two separate studies.

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[2] Lister, J. Lactic fermentation and its bearing on pathology. *Pharm. Jour. and Trans.* (Pathological Society of London) III Series, 8:555–558; 572–575. 1878.

[3] Schulz, L. Ueber den Schmutzgehalt der Würzburger Marktmilch und die Herkunft der Milchbakterien. *Arch. Hyg.* 14:260–271. 1892.

The work of Schulz was confirmed by Moore,[4] who concluded that "Freshly drawn fore milk contains a variable number of bacteria, varying in number from a few individuals to many thousand per cubic centimeter. These are distributed among several species. The last milk drawn at a regular milking contains, as compared with the fore milk, very few micro-organisms. It is the exception, however, to find a sample of milk that is free from micro-organisms unless it is taken during the latter part of the milking process from a single quarter of the udder."

As the result of these and similar observations it was held that bacteria might find their way into the teat opening and multiply to some extent in the milk cistern, but that they were washed out more or less completely during the milking process.

In his earlier paper Moore suggested the desirability of direct examinations of excised tissue from functioning udders of freshly slaughtered milch cows as a means of settling the question of the bacterial invasion of the upper portions of udders. He later[5] reported the results of such examinations and this work was extended by one of his students, Ward.[6] These direct examinations showed that bacteria were uniformly present in the finer subdivisions of the udder. The work of Bolley[7] had indicated that certain species were able to persist in an udder for considerable periods and Moore and Ward[8] studied an instance where this udder contamination was of considerable economic importance.

Later work has confirmed the conclusion of Moore and Ward that bacteria are practically always present in the udders of healthy cows but it has also shown that the numbers of bacteria

[4] Moore, V. A. Preliminary investigations concerning the number and nature of bacteria in freshly drawn milk. U. S. Dept. Agr. An. Ind. An. Rpt. 12 & 13:261–266. 1897.

[5] Moore, V. A. The normal bacterial invasion of the cow's udder. *Proc. Soc. Prom. Agr. Sci.* **1899**:110–113.

[6] Ward, A. R. The persistence of bacteria in the milk ducts of the cow's udder. *Jour. App. Micros.* 1:205–209. 1898; also The invasion of the udder by bacteria. N. Y. (Cornell) Agr. Exp. Sta. Bul. 178. 1900.

[7] Bolley, H. L. Ueber die Konstanz von Bakterienarten in normaler Roh-(fore) Milch. *Cent. Bak.* II Abt. 1:795–799. 1895.

[8] Moore, V. A., and Ward, A. R. An inquiry concerning the source of gas and taint producing bacteria in cheese curd. N. Y. (Cornell) Agr. Exp. Sta. Bul. 158. 1899.

present vary within wide limits. This is well illustrated by the work of Hastings and Hoffmann.[9] They obtained the following results from a study of the freshly drawn milk from three cows:

NAME.	Days sampled.	Average per cc.	Maximum per cc.	Minimum per cc.
Brownie	61	31,000	305,000	1,700
Dorine	33	191,000	3,500,000	2,500
Merney	27	810	4,250	50

Two-thirds of these samples were taken from the pail at the close of the milking, the remainder being taken at the middle of the milking in sterile flasks. The variation in the method of sampling did not seem to affect materially the observed germ content.

It has long been held that cleanliness in the stable would influence favorably the germ content of udders but direct evidence on this point has only recently been available. Atwood and Giddings[10] tested the influence both of sealing the opening of the teat so as to exclude all external contamination and of injecting various substances into the milk cistern. Where the end of the teat was treated with carbolized vaseline and covered with adhesive tape the germ content was but little reduced. Where the cistern was treated with chemicals there was first a reduction of germ content but this was followed by a marked rise and accompanied by an inflammation of the gland.

PRESENT STUDIES.

These studies of the normal flora of cows' udders have extended over a considerable period. During 1900–02 examinations were made of the strippings from 17 cows. At each examination samples were taken from each quarter of the udder and 324 samples were studied. These examinations were made, for most part,

[9] See footnote 1.

[10] Atwood, H., and Giddings, N. J. Experiments in the production of sanitary milk. W. Va. Agr. Exp. Sta. Bul. 134. 1911.

either by L. A. Rogers or J. F. Nicholson.* The samples were collected in sterile test tubes, at times with most elaborate preparation of the animal, at others with no preparation aside from the ordinary grooming. The results did not indicate that these variations in the preparation of the animal affected the germ content of the samples.

Plates were made promptly on agar or gelatin and at times on both. The gelatin plates were ordinarily counted at the end of five days at room temperature, the agar plates after three days at 37°C. Owing to the undeveloped state of bacteriological classification at that time only quantitative results were obtained. While these observations were merely preliminary they were of some value in establishing the range of bacterial content which may be expected in practice.

During 1907–11 one of us (W) collected and studied 766 samples from 20 cows in the Station herd. Only quantitative results were obtained from approximately the first 50 of these samples but the remainder were studied both quantitatively and qualitatively. Owing to the lapse of time since the study of 1900–02, the herd had entirely changed. The destruction of the Station barns by fire in 1904 had further changed conditions so that these two sets of observations of the Station herds have the same relative value as would the study of two separate herds.

This somewhat extended study of conditions in these two herds was supplemented by a study of a sample from each quarter of the udder of 46 cows belonging to Mr. A. G. Lewis or a total of 184 samples from this herd.

Accordingly, the present publication is a discussion of the quantitative relationships of 1,274 samples representing 83 cows and of the qualitative findings from 900 samples representing 63 cows.

* Mr. Rogers is now head of the research laboratory of the Dairy Division of the Bureau of Animal Industry, U. S. Department of Agriculture, and Prof. Nicholson, head of the Bacteriological Department of the University of Idaho. When the above work was done they were Assistant Bacteriologists at this Station.

TECHNIQUE.

The last 922 samples were obtained and handled in accord with the following general outline:

All samples were collected from the afternoon milkings and those from the Station herd were taken from each cow on three successive days. The cows from which the samples were taken had been carefully groomed but no local disinfection of the udder was attempted. The milking was done by hand, in the ordinary way, directly into sterile test tubes. With the exception of a single series, where the object was to test the condition of the milk at the various stages of milking, the samples were from the close of the milking. Care was exercised that the sample was the product of a single stream of milk and that the sterile tube was opened for the minimum time and was held in such a manner as to be exposed to the minimum amount of contamination.

The samples from the Station cows were taken to the laboratory and the plating completed within an hour, those from other sources within three hours. The medium used was as follows:

Agar	15 grams.
Peptone (Witte)	10 "
Lactose, c.p.	10 "
Beef extract (Liebig)	5 "
Water (dist.) to make a volume of 1000 cc.	

The reaction of this medium ordinarily was between 1.2 and 1.5 per ct. normal acid to phenolphthalein. Whenever it exceeded the higher figure it was reduced by the addition of NaOH. This medium was chosen to permit incubation both at 20° C. and 37° C.

In plating, one cubic centimeter of milk was divided between two petri dishes and approximately 8 cc. of the agar was added to each plate. The sum of the colonies developing on these two plates was taken as the germ content of the milk. The plates were held at room temperature (20–23°C.) for five days and the first count made. They were then placed at 37°C. for two additional days and counted again. All counts were made under a lens magnifying four diameters.

In order to simplify the presentation the numerical results given in this publication are those obtained after an incubation for five days at 20–23° C. followed by two days at 37° C. unless otherwise stated.

EFFECT OF INCUBATION TEMPERATURE ON THE COUNT.

The periods of incubation officially recommended are five days at 21°C. or two days at 37°C. The lower temperature is ordinarily chosen, since gelatin, which is preferred in qualitative work on account of its better differentiation of colonies, will not remain solid at the higher temperature.

The accuracy of this five-day incubation of agar plates was tested as follows: Samples were collected at the beginning, middle and close of the milking, from each quarter of the udder of five cows and plated on agar. Counts of the plates were made after incubating five days at 20–23° C. and again after two additional days at 37° C. The percentage of increase found at the second count of the 18 samples from each quarter is given in Table I.

TABLE I.—VARIATION IN BACTERIAL COUNT AFTER ADDITIONAL INCUBATION AT 37° C.

(First count made after 5 days at 20–23° C.)

NAME.	INCREASE AT SECOND COUNT.			
	R. F.	R. B.	L. F.	L. B.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*
Hammond No. 2	102	85	585	314
Millie G	38	0	14	8
Carey F	25	3	11	3
Gertie No. 3	410	2	18	25
Hammond F. No. 2	21	9	46	10

REMARK.—Letters R. F., R. B., etc., indicate, respectively, the right front, right back, left front and left back quarter of udder.

From the above table, which gives the results from a study of 360 samples of milk, it is seen that the effect of incubation at higher temperature is most marked in the milk from Hammond No. 2 and least in that from Carey F.

With Millie G. the results of both counts were the same from the right back quarter while the count after incubation at 37°C. was the higher in 5 samples from the right front, 11 from the left front and 4 from the left back out of the 18 samples examined from each quarter.

This marked variation in the effect of high temperature is due to variations in the flora. As will be described under the head of udder flora there were isolated 11 micrococci, a bacterium and a yeast, the colonies of which did not ordinarily appear at the lower temperature. Naturally these forms were more common in the udders of particular cows and were more frequently found in some quarters than in others. The uneven distribution of these forms in the samples is to be ascribed in part to the formation of clumps or colonies within the udder as has been described by Breed.[11] These colonies are occasionally observed in samples from the udder by means of his technique and the number of colonies appearing on the plate is dependent upon the extent to which these clumps are broken up in the plating process. It is practically certain that our present plate methods give an inadequate idea of the numbers of bacteria actually present in freshly drawn cows' milk.

CHOICE OF METHODS OF SAMPLING.

In undertaking a combined quantitative and qualitative study of the udder germs it was necessary to obtain samples which were representative both of the total numbers and of the kinds of germs present. To obtain accurately the total numbers it would seem desirable to draw a sample from the well mixed product of a quarter which had been milked under careful conditions. However, under the best of conditions some contamination will occur during the milking process and this procedure would raise the question as to whether organisms isolated from such samples were really representatives of the udder flora.

[11] Breed, R. S. The determination of the number of bacteria in milk by direct microscopical examination. *Cent. Bak.* II Abt. 30:337–340. 1911.

The possibility of taking a sample direct from the udder which would give a satisfactory measure of the bacteria present and at the same time reduce the danger of outside contamination to the minimum was tested by milking into sterile test tubes at the beginning, the middle and at the close of the milking process. These samples were obtained from five cows on six successive days and the results of the counts summarized in Table II.

TABLE II.—COMPARISON OF BACTERIAL CONTENT AT BEGINNING, MIDDLE AND END OF MILKING.

NAME.	FIRST OF MILKING.				MIDDLE OF MILKING.				LAST OF MILKING.			
	R. F.	R. B.	L. F.	L. B.	R. F.	R. B.	L. F.	L. B.	R. F.	R. B.	L. F.	L. B.
Hammond No. 2	112	511	422	494	103	109	89	35	12	69	95	134
[illegible] G.	2,221	3,546	73	436	681	1,714	48	272	1,426	2,715	7	280
[illegible] F.	8	342	8	40	15	48	4	29	4	67	13	7
[illegible] No. 3	709	68	8	48	339	3	4	10	246	1	3	5
Hammond No. 2	9	8	5	92	5	5	4	74	34	24	4	334
Average	612	895	103	222	271	376	26	84	344	575	24	152
General average	458				187				274			

REMARK.—Letters R. F., R. B., etc., indicate, respectively, the right front, right back, left front and left back quarter of udder.

The results from these 360 samples accord with the observation of Stocking[12] in that those at the middle of the milking contain a smaller number of germs than those taken either toward the beginning or at the close of the process.

The average germ content of the entire 360 samples was 306 per cc. The averages for the three successive sets of samples were 458, 187 and 274 respectively. From this it is seen that the average number of germs in the strippings, 274, was much more nearly equal to the grand average, 306, than the average from either of the other sets of samples. The agreement between these two numbers is reasonably close.

The accuracy of the samples of strippings as a measure of the germ content of the udder was further tested by examining

[12] Stocking, W. A. Quality of milk as affected by common dairy practices. Conn. (Storrs) Agr. Exp. Sta. Ann. Rpt. 18 (1906):66–90. 1907.

samples from the strippings and from the whole milk of a cow on three successive milkings. In this experiment the cow was carefully groomed, her flanks and udder were moistened and her teats and the hands of the milker were vaselined. A half-pint of milk was rejected from each test and the remainder of the milk from each quarter was milked into a sterile four-inch funnel, placed in a sterile bottle. Plates were promptly made from a sample of the strippings and from a sample of the thoroughly mixed milk from each quarter. The results from these plates are given in Table III.

TABLE III.—RELATION OF BACTERIAL CONTENT OF ENTIRE YIELD OF MILK AND OF STRIPPINGS.

DATE.	R. F.		R. B.		L. F.		L. B.	
	Whole milk.	Strippings.	Whole milk.	Strippings.	Whole milk.	Strippings.	Whole milk.	Strippings.
6/11/P.M.	......	56	401	716	53	26	140	173
6/12/A.M.	216	429	629	......	646	244	442	493
6/12/P.M.	36	305	789	975	88	22	96	105
Average	126	263	606	845	262	97	226	257

Average of strippings, 365.
Average of whole milk, 305.
REMARK: Letters R. F., R. B., etc., indicate, respectively, the right front, right back, left front and left back quarter of udder.

From these results it is seen that while there is a fairly good agreement between the germ content found in the strippings and in the whole milk the germs are distinctly more abundant in the strippings. It should be remembered that in this case one-half pint of the first milk from each quarter was rejected, thus reducing the number of germs found in the whole milk.

It will be noted from Table II that the germs in the strippings are slightly less abundant and from Table III slightly more abundant than in the corresponding whole milk. These results suggest that with a larger number of observations the germ content of the strippings would be found to be practically identical with that of the milk of each drawing considered as a whole.

In view of these results and of the desirability of obtaining samples with as little contamination as possible the following studies of the germ content of udders were made with samples drawn, at the close of the milking process, directly into sterile test tubes.

OBSERVED NUMERICAL CONTENT.

Ordinarily it is desirable to present the detailed results so that each student of the subject may form independent judgment regarding existing relations. In the present instance limitations of space and the tediousness of presenting the merely numerical results from over 1,000 samples led to the collection of the data under the following headings:

TABLE IV.— AVERAGE BACTERIAL CONTENT OF MILK IN UDDER.

	Right Front Quarter of Udder.			Left Front Quarter of Udder.			Right Back Quarter of Udder.			Left Back Quarter of Udder.		
	Total No. germs.	No. samples.	Average per cc.	Total No. germs.	No. samples.	Average per cc.	Total No. germs.	No. samples.	Average per cc.	Total No. germs.	No. samples.	Average per cc.
Herd of 1900–02.....	33,109	79	419	29,074	77	378	52,263	80	653	49,387	80	617
Herd of 1910–11.....	36,758	185	199	22,702	174	130	117,730	185	636	129,841	186	698
Herd of A. G. L.....	7,414	46	161	4,925	46	107	27,484	46	597	15,718	46	342
Averages............	....	....	249	....	....	191	....	....	635	....	....	625

Average germ content per cc. in 316 samples from herd of 1900–02........ 518
Average germ content per cc. in 730 samples from herd of 1910–11........ 420
Average germ content per cc. in 184 samples from herd of A. G. L........ 320
Average germ content per cc. in 1230 samples from 78 cows............... 428

Since it is important to know not only the average number of germs present in the udder but also the maximum number present at any one time, the data have been arranged in Table V to show the number of samples which contained over 1,000 germs per cubic centimeter as well as the maximum number found in samples from each quarter of the udder in each of three herds.

TABLE V.— SAMPLES CONTAINING MORE THAN 1000 GERMS PER CUBIC CENTIMETER.

HERD.	R. F. QUARTER. SAMPLES.			L. F. QUARTER. SAMPLES.			R. B. QUARTER. SAMPLES.			SAMPLES.		
	Total.	Above limit.	Maximum germ content.	Total.	Above limit.	Maximum germ content.	Total.	Above limit.	Maximum germ content.	Total.	Above limit.	Maximum germ content.
	No.	*No.*	*Per cc.*	*No.*	*No.*	*Per cc.*	*No.*	*No.*	*Per cc.*	*No.*	*No.*	*Per cc.*
1900–02.......	79	10	4,256	77	9	4,632	80	16	9,967	80	13	16,000
1910–11.......	185	12	4,120	174	8	3,130	185	31	14,280	186	33	15,750
A. G. L.......	46	2	3,180	46	2	1,340	46	5	16,610	46	4	5,280
Totals....	310	24	4,256	297	19	4,632	311	52	16,610	312	50	16,000
Above limit..	8 per ct.			6 per ct.			17 per ct.			16 per ct.		

Per ct. of all samples above limit, 12.
Maximum observed germ content per cc., 16,610.

The maximum content here given, 16,610, may not be the highest actually present among the more than 1,200 samples, since there were four samples from the herd of 1900–02 and two from the herd of 1910–11 where the plates were not counted on account of the large number of colonies present. Three of the four earlier samples were from a single cow and the two later samples were obtained on the same day from another cow.

TABLE VI.— DISTRIBUTION OF HIGH-GERM-CONTENT SAMPLES IN HERD OF 1910–11.

	HERD OF 1910–1911.											
	RIGHT FRONT QUARTER OF UDDER.			LEFT FRONT QUARTER OF UDDER.			RIGHT BACK QUARTER OF UDDER.			LEFT BACK QUARTER OF UDDER.		
	Sample.	Over 1,000	Maximum.	Sample.	Over 1,000	Maximum.	Sample.	Over 1,000	Maximum.	Sample.	Over 1,000	Maximum.
Gertie F. No. 3......	9	0	......	9	0	......	9	0	......	9	0	......
Carey S...........	3	0	......	3	0	......	3	0	......	3	0	......
Anna G...........	3	1	1,000	3	0	......	3	0	......	3	0	......
Carey D. H........	3	0	......	3	0	......	3	0	......	3	0	......
Hammond F. No. 2..	9	0	......	9	0	......	9	0	......	9	1	1,730
Carey F...........	9	0	......	9	0	......	9	0	......	9	0	......
Millie G..........	10	7	2,700	10	0	......	10	8	10,440	10	0	......
Hammond No. 2.....	9	0	......	9	0	......	9	0	......	9	0	......
Millie D..........	26	4	4,120	26	6	3,130	26	12	14,280	26	7	3,780
Millie F. B. B......	15	0	......	15	0	......	15	0	......	15	0	......
Mabel S. F.........	15	0	......	15	2	1,254	15	0	......	15	0	......
Ruth S............	12	0	......	....	.....	......	12	3	4,340	12	6	15,750
Gertie F. No. 2......	24	0	......	24	0	......	24	0	......	24	9	10,458
Ruth F...........	23	0	......	24	0	......	23	8	6,720	24	10	5,040
Millie F...........	15	0	......	15	0	......	15	0	......	15	0	......
	185	12	......	174	8	......	185	31	......	186	33	......

The fact that the small number of samples containing over 1,000 per cc. were not evenly distributed over the herd but were obtained from a relatively small number of the cows is shown by Table VI.

It will be seen that of these 15 cows only three gave samples containing over 1,000 per cc. from the front right quarter, two from the front left quarter, four from the back right and five from the back left quarter.

These rather low numbers are in contrast with many of the earlier observations, particularly those of Hastings and Hoffmann.[13] These investigators were plainly working with two very unusual animals, though none the less interesting and worthy of study on this account. The high numbers frequently obtained by other investigators were usually due to samples drawn early in the milking process and influenced by the initial high numbers of the fore milk.

Another point clearly shown in Tables IV and V is the striking difference in germ content between the front and the back quarters of the udder. According to Table IV the average content of the samples from the front quarter was 191 and 249 per cc., respectively, while those from the back quarters gave averages of 625 and 635 per cc. That this is not an accidental relationship is further indicated by the fact that in each of the three herds studied the average germ content of the back quarters is from two to four times that of the corresponding front quarters.

This same relationship is brought out in Table V, where it is shown that of the samples from the front quarters of the udder only 6 and 8 per ct., respectively, had a germ content of over 1,000 per cc., while this number was exceeded in 16 and 17 per ct., respectively, of the samples from the back quarters. The maximum germ content found in samples from the front quarters was 4.632 per cc., while over 16,000 per cc. were found in the back quarters.

A comparison of the germs found in the sets of samples taken from a single cow on any given evening, in the case of the 11

[13] See footnote 1.

cows which were most frequently tested in the Station herd, shows that the germs were more numerous in the back quarters in 68 per ct. of the 213 sets of samples. The number of these sets of samples varied with the different cows from 13 to 26. Sets in which the germ content was more numerous in the back quarters predominated in the case of 9 of the 11 cows. The cases in which the larger germ contents were found in the front quarters were largely confined to the early part of the lactation period or to cases where a front quarter contained large numbers of a particular germ which was practically absent from the corresponding back quarters.

The cause and significance of this unequal distribution of germ life in the front and back quarters of the udder is unknown but the fact is evident from any point of view from which the data has been considered.

Relation of bacterial count to period of lactation.— In searching for the influences which keep the bacteria in the udder within the comparatively narrow bounds which are shown by the preceding data, it will be of interest to observe the relation of the germ content to the period of lactation of the animal. The data were not complete with regard to the period of lactation in a few cases but the results from 1,119 samples are given in Table VII.

TABLE VII.— BACTERIA IN UDDER AT VARIOUS MONTHS OF LACTATION.

	1–5 days.	6–30 days.	2d month.	3d month.	4th month.	5th month.	6th month.	7th month.	8th month.	9th month.	10th month.	11th month.	12th month.
Cows.........	6	13	13	12	8	13	10	13	14	5	9	6	2
Samples.......	48	86	117	113	73	124	74	129	138	80	100	29	8
Total germs....	36,361	21,236	64,214	16,587	3,081	40,853	12,553	13,215	47,571	7,634	4,357	2,598	4,975
Average per cc.	757	247	549	147	42	329	170	102	345	95	44	90	622

An examination of the above table shows that, with the exception of the two extremes of the table, there is no evidence of any well marked connection between this germ content and the period of lactation. It will be observed that the samples obtained

during the first five days were separated from those during the remainder of the first month. These first samples were within the colostrum period of flow and a majority of them were obtained at the first milking. The relatively high average of these samples is characteristic of practically all of them and it seems probable that under average conditions the germ content of the colostrum is higher than that of the milk at any later period of lactation.

The high average for the twelfth month, on the other hand, is due to high counts in two of the samples coming from a single cow so that the mathematical average of all of the counts is deceptive. The small numbers found in six of the eight samples during the twelfth month, taken in connection with the results from the two preceding months, suggest that toward the close of the lactation period there is a slight tendency for the germ content of the udder to fall.

It should be observed that these deductions have been obtained by massing together observations without regard to any peculiarities of the individuals from which the samples had been obtained. Deductions from such massed data can well be tested by the results obtained from individual cows. As has been already explained, successive samples were taken over a considerable period from seven cows and a smaller number of samples from 11 others. The results from these individual sets of samples are in almost complete accord with the massed data. The colostrum contains rather high numbers of bacteria, the numbers varying greatly with the different animals. With the secretion of normal milk the numbers fall noticeably and remain reasonably constant during the remainder of the lactation period, usually decreasing slightly toward its close. It should be remembered, however, that even under the most favorable conditions only a single set of three samples was taken once per month and more frequent sampling might disclose minor variations.

It should be further remembered that these statements are intended to apply only to the germ content under normal conditions.

In cases of inflammation of the udder the germ content is frequently, if not always, markedly increased.

Relation of bacterial count to the age of the cow.— The age is unknown in the case of some of the cows whose udder content has been studied, but the results from 1,085 of the samples, arranged according to the ages of the cows, are given in Table VIII.

TABLE VIII.— AVERAGE BACTERIAL CONTENT OF UDDERS OF COWS OF DIFFERENT AGES.

	Two years.	Three years.	Four years.	Five years.	Six years.	Seven years.	Eight years.	Nine years.	Ten years.	Eleven years.
Cows	4	15	25	6	5	10	13	3	2	1
Samples	16	183	365	136	36	116	173	37	19	4
Bacteria per cubic centimeter	99	126	269	233	166	659	750	412	166	2,434

It will be noted that the irregular results shown in years 2, 6, 10 and 11 are associated with a small number of samples from a small number of cows. It is manifest that under such conditions the individual peculiarities of the cows would be most evident. The average of 2,434 for the eleventh year represents four samples from a single cow and cannot be considered as a representative average. This same cow furnished a part of the samples for the preceding year and the average of these samples was 303. The samples from the other cow were even lower so that the average for the tenth year is one of the lowest of the series.

Taken all in all, the above table does not offer satisfactory evidence that the age of the cow has any distinct influence upon the germ content of the udder.

Other factors.— Of the factors influencing the udder content inflammation is one commonly considered in public health work. It is a matter of general knowledge that inflamed udders commonly have high germ contents and such udders have been located through the organisms which are abundant in their secretions. Since inflammation is a pathological condition it has not been intentionally

investigated in connection with this study of the normal udder but its influence may have entered into the results obtained.

In discussing the relation of the germ content to the period of lactation it was observed that during the first few days germs were distinctly more abundant than later and that toward the close of lactation the numbers tended to decrease. It will be remembered that during the first few days the udder is practically always in an inflamed condition. Later, while the normal udder is in full flow, it is daily subjected to complete distention, which is the first stage of inflammation. Finally, when the flow begins to fall off rapidly, the udder is no longer fully distended, and this inflammatory condition is not present. It is noteworthy that the three stages in germ content which were noted (see page 103) are fairly parallel with these three relations to inflammation. In how far this influence of inflammation is responsible for the observed variations in germ content and the method by which its influence is exerted can be best determined after the question of inflammation has been thoroughly studied.

UDDER FLORA.

In studying the flora of any region either of two distinct ideas may be followed; the aim may be to include all of the forms which are ever found in that region or it may be restricted to those which persist in the region for a considerable time and may be considered as fairly permanent residents. In the earlier studies of a flora this latter plan has much to commend it since it is far simpler in execution.

During these qualitative studies samples were obtained under two quite different sets of conditions and for somewhat different purposes.

More than 750 samples were obtained from 15 cows at the station barn where conditions were largely under control and the milkers were accustomed to assisting in the collection of samples. These samples were taken on three successive days from each cow and only those forms were isolated for study which appeared

in two or more samples and in such numbers as to make it evident that they were fairly permanent inhabitants of the udder. There is little reason to doubt but that the forms thus isolated are true members of the udder flora.

Feeling that more extensive observations should be made, 184 samples were obtained on a single occasion from 46 cows in another herd. In this case the samples were drawn into sterile test tubes by either one of us (W) or by Dr. R. S. Breed. Having but a single sample from each quarter of the udder there was no opportunity for observing the persistence of a given form. All plates showing evidence of contamination were rejected and only those types of colonies which were present in considerable numbers were selected for study. While the attempt was made to exclude all contaminating forms there remains the possibility that some of the forms thus selected were not true members of the udder flora.

In any work of this nature the personal element is necessarily large. Success in separating the colonies upon any plate into classes, each of which represents a single group of organisms, requires both experience and judgment. The ability to carry in mind the distinguishing characteristics of a growing list of such classes, so that the colonies present may be correctly assigned to classes which were established months earlier, is especially difficult to acquire. The accuracy of this separation can be tested in a measure by the extended study of representatives of these classes and in this investigation cultures were thus studied in all cases where doubt arose as to the proper classification. However, on account of the large number of colonies which must be classified and the amount of time consumed by the detailed study of selected forms it follows that the classification records must depend largely for their accuracy upon the judgment of the worker.

One of the authors (W) devoted practically his entire attention for approximately one and one-half years to the examination of samples from cows' udders and the classification of the forms found there; and he is to be held personally responsible for the

accuracy of all of the data presented in this portion of the publication.

Method of classification.— The attempt at separating and describing the forms of bacteria which occur in cows' udders meets the difficulty common to an attempt at such a classification in any division of the bacterial flora, the lack of a satisfactory system of classification.

The older system of classification, which was widely applied to this class of bacteria by Conn, Esten and Stocking,[14] proceeded on the assumption that bacteria were especially prone to vary in their physiological activities and accordingly the groups into which they might be arranged must have shadowy and uncertain limits.

The newer system of the Society of American Bacteriologists accepts the division into genera according to the classification of Migula. It proceeds on the assumption that the members of each genus can be reduced to groups, the members of each group agreeing exactly in the possession of or the lack of certain physiological functions. A novel feature in this system is the provision for expressing these functions numerically. By writing these numbers in a definite order the most important physiological activities of the organism in question are expressed tersely and in a form which is most favorable for direct comparison. By arranging many such numerical expressions in order, those with identical physiological functions are grouped together and the numerical expression which characterizes the group becomes their "group number."

While this newer system substitutes scientific accuracy for the hazy generalizations which characterized the older, in its present form it can hardly be considered as fully perfect. Its manifest advantage as a means of tersely recording the observed facts regarding the isolated cultures led to its use in these studies.

The numbers used in recording various important physiological reactions were as follows:

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[14] Conn, H. W., Esten, W. M., and Stocking, W. A. A classification of dairy bacteria. Conn. (Storrs) Agr. Exp. Sta. Ann. Rpt. 18 (1906):91–203. 1907.

A NUMERICAL SYSTEM OF RECORDING THE SALIENT CHARACTERS OF AN ORGANISM.
(GROUP NUMBER.)

100.	Endospores produced.
200.	Endospores not produced.
10.	Aerobic (Strict).
20.	Facultative anaerobic.
30.	Anaerobic (Strict).
1.	Gelatin liquefied.
2.	Gelatin not liquefied.
0.1	Acid and gas from dextrose.
0.2	Acid without gas from dextrose.
0.3	No acid from dextrose.
0.4	No growth with dextrose.
.01	Acid and gas from lactose.
.02	Acid without gas from lactose.
.03	No acid from lactose.
.04	No growth with lactose.
.001	Acid and gas from saccharose.
.002	Acid without gas from saccharose.
.003	No acid from saccharose.
.004	No growth with saccharose.
.0001	Nitrates reduced with evolution of gas.
.0002	Nitrates not reduced.
.0003	Nitrates reduced without gas formation.
.00001	Fluorescent.
.00002	Violet chromogens.
.00003	Blue "
.00004	Green "
.00005	Yellow "
.00006	Orange "
.00007	Red "
.00008	Brown "
.00009	Pink "
.00000	Non-chromogenic.
.000001	Diastasic action on potato starch, strong.
.000002	Diastasic action on potato starch, feeble.
.000003	Diastasic action on potato starch, absent.
.0000001	Acid and gas from glycerine.
.0000002	Acid without gas from glycerine.
.0000003	No acid from glycerine.
.0000004	No growth with glycerine.

In order to make the results of the present study as intelligible as possible to all workers the probable synonyms in the classification of Conn, Esten and Stocking have been added.

The precautions which were observed in making certain that the forms studied were actually derived from the udder have been explained under the head of technique. In classifying these organisms all determinations were made in triplicate and when for any reason the reaction was in doubt triplicate cultures were again prepared on a later date.

The preparation of the media and the determination of the reactions were in accord with the official methods of the American Public Health Association[15] except that the reduction of nitrate to nitrite was determined by the iodine-starch reaction according to the suggestion of Smith for the reasons given in Technical Bulletin 13.[16]

OBSERVED FORMS.

In accordance with the above systems of classification the observed udder flora may be summarized as follows:

TABLE IX.— LIST OF UDDER BACTERIA.

Cultures Studied.	Culture No.	Society No.	Name.
1	1	Bacterium......211.2222533	*Bacterium lactis brevis*
1	2	Bacterium......211.2232523	*Bacterium lactis flocculus*
2	3	Bacterium......211.2232533	*Bacterium lactis brevis*
2	4	Bacterium......211.3332513	*Bacterium lactis citronis*
1	5	Bacterium......212.2223023	*Bacterium lactis non-acidi*
1	6	Bacterium......212.2232033	*Bacterium lactis non-acidi*
2	7	Bacterium......212.2233033	*Bacterium lactis non-acidi*
1	8	Bacterium......212.2233633	*Bacterium lactis aureum II?*
1	9	Bacterium......212.2322033	*Bacterium lactis non-acidi*
1	10	Bacterium......212.2332033	*Bacterium lactis non-acidi*
1	11	Bacterium......212.2332633	*Bacterium lactis aureum II?*
6	12	Bacterium......212.3332033	*Bacterium lactis Connii?*
2	13	Bacterium......212.3333033	*Bacterium lactis Connii?*
1	14	Bacterium......222.2222032	*Bacterium lactis acidi*
3	15	Micrococcus 211.2222533	*Micrococcus lactis varians*
1	16	Micrococcus 211.2222623	*Micrococcus lactis varians A.?*
1	17	Micrococcus 211.2222633	*Micrococcus lactis varians?*
1	18	Micrococcus 211.2222922	*Micrococcus lactis varians*
3	19	Micrococcus 211.2223032	*Micrococcus lactis albidus*
8	20	Micrococcus 211.2223033	*Micrococcus lactis albidus*
4	21	Micrococcus 211.2223532	*Micrococcus lactis varians?*
2	22	Micrococcus 211.2223533	*Micrococcus lactis varians?*
1	23	Micrococcus 211.2223623	*Micrococcus lactis rugosus*
6	24	Micrococcus 211.2223633	*Micrococcus lactis varians?*
2	25	Micrococcus 211.2223733	*Micrococcus lactis rubidus?*
1	26	Micrococcus 211.2223923	*Micrococcus lactis rugosus*
3	27	Micrococcus 211.2223933	*Micrococcus lactis rugosus?*
1	28	Micrococcus 211.2232033	*Micrococcus lactis albidus*
9	29	Micrococcus 211.2233033	*Micrococcus lactis albidus*
1	30	Micrococcus 211.2233533	*Micrococcus lactis varians?*
1	31	Micrococcus 211.2323032	*Micrococcus lactis albidus*
4	32	Micrococcus 211.2323033	*Micrococcus lactis albidus?*

15 Amer. Public Health Association. Report of the committee on standard methods for the bacterial analysis of milk. *Amer. Jour. Pub. Hyg.* **20**:315–345. 1910.

16 Harding, H. A. The constancy of certain physiological characters in the classification of bacteria. N. Y. (State) Agr. Exp. Sta. Technical Bul. 13. 1910. Also in Ann. Rpt. of same Station **29** (1910):55–93. 1911.

TABLE IX (*concluded*).

Cultures Studied.	Culture No.		Society No.	Name.
1	33	Micrococcus	....211.2323532	*Micrococcus lactis varians?*
1	34	Micrococcus	....211.2323533	*Micrococcus lactis varians?*
1	35	Micrococcus	....211.2323932	*Micrococcus lactis rugosus?*
1	36	Micrococcus	....211.2332523	*Micrococcus lactis varians?*
1	37	Micrococcus	....211.2333033	*Micrococcus lactis albidus?*
1	38	Micrococcus	....211.3233033	*Micrococcus lactis albus?*
1	39	Micrococcus	....212.2222023	*Micrococcus lactis gigas?*
2	40	Micrococcus	....212.2222033	*Micrococcus lactis acidi*
1	41	Micrococcus	....212.2222532	*Micrococcus lactis aureus*
1	42	Micrococcus	....212.2222533	*Micrococcus lactis aureus?*
1	43	Micrococcus	....212.2223032	*Micrococcus lactis acidi*
1	44	Micrococcus	....212.2223532	*Micrococcus lactis aureus*
5	45	Micrococcus	....212.2223033	*Micrococcus lactis acidi*
1	46	Micrococcus	....212.2223523	*Micrococcus lactis aureus*
1	47	Micrococcus	....212.2223533	*Micrococcus lactis aureus?*
1	48	Micrococcus	....212.2232033	*Micrococcus lactis acidi?*
1	49	Micrococcus	....212.2232533	*Micrococcus lactis aureus?*
1	50	Micrococcus	....212.2323033	*Micrococcus lactis acidi?*
1	51	Micrococcus	....212.2333533	*Micrococcus lactis areus?*
5	52	Micrococcus	....212.3332033	*Galactococcus versicolor*
4	53	Micrococcus	....212.3333033	*Galactococcus versicolor*
3	54	Micrococcus	....212.3333533	*Micrococcus lactis citreus*
1	55	Micrococcus	....212.3333633	*Micrococcus lactis flavus?*
1	56	Micrococcus	....221.2222032	*Micrococcus lactis albidus?*
1	57	Micrococcus	....221.2222622	*Micrococcus lactis varians?*
1	58	Micrococcus	....221.2222632	*Micrococcus lactis varians*
1	59	Micrococcus	....221.2223023	*Micrococcus lactis albidus*
4	60	Micrococcus	....221.2223033	*Micrococcus lactis albidus*
1	61	Micrococcus	....221.2223513	*Micrococcus lactis varians?*
3	62	Micrococcus	....221.2223532	*Micrococcus lactis varians?*
1	63	Micrococcus	....221.2223533	*Micrococcus lactis varians?*
1	64	Micrococcus	....221.2223632	*Micrococcus lactis varians?*
1	65	Micrococcus	....221.2233633	*Micrococcus lactis rugosus?*
2	66	Micrococcus	....222.2222034	*Streptococcus lacticus?*
2	67	Micrococcus	....222.2223533	*Micrococcus lactis aureus*
1	68	Streptococcus	...211.2223033	*Micrococcus lactis albidus?*
1	69	Streptococcus	...222.2223033	*Streptococcus lacticus?*
1	70	Yeast	..........212.2332013	
1	71	Yeast	..........212.2332033	

The finding of only 71 distinct groups of organisms in a study of over 900 samples of milk from the udder suggests that there is a fairly small and distinct flora of this region which recurs in the various samples.

The showing made by the older system of classification is even more striking since only about one-fourth as many species are represented. This decrease in number of species, however, is more apparent than real since barely 10 per ct. of the cultures were typical members of the groups described by Conn, Esten and

Stocking. Nearly one-half of them differed so materially from the types described by the above authors that they were listed under their nearest allies with the addition of an interrogation point for the double purpose of indicating their general relationship and of avoiding the coinage of any more names. The remaining 40 per ct. come more or less clearly under the shadowy outlines of the types of Conn and his colleagues.

Under the heading " cultures studied " is given the number of cultures which were studied in detail and whose group number was fully determined. A larger number of cultures were given a preliminary study, sufficient to convince the worker that the culture finally studied in detail was a true type of the class of colonies which it was taken to represent. The extended study of a considerable number of cultures of the same group indicates not so much the frequency with which the cultures were encountered as the variation in colony appearance which rendered the identity doubtful in the mind of the observer.

The present group number is not perfect and in some cases two or more really distinct strains are undoubtedly included in a single group. The probability of such inclusion is greater in the groups having dissimilar colonies as noted above. It should be noted that whatever criticism is directed against the Society classification system because it does not separate all distinct strains bears even harder on the older classification since none of these collections of cultures which were grouped together by the Society system were separated by the older grouping.

The udder organisms undoubtedly enter through the teat opening and advance into the finer subdivisions of the udder at times against the force of gravity and the flow of milk. Under such circumstances it would seem that swimming organs would be a contributing factor in their struggle for existence. Since the genus bacillus — motile rods — is absent from the above list of udder organisms it is probable that flagella are correlated with something else which is distinctly unsuited to udder conditions.

The genus Streptococcus is also conspicuous because only two

representatives were found. The absence of this genus was noted early in the qualitative work and attention given to the detection of streptococci. Neither of the two forms here listed are typical members of the genus, their tendency to form chains being rather weak. It will also be noted that two strains of *Streptococcus lacticus* are among the named species with an interrogation point. These strains were not streptococci but agreed fairly closely with the description of that species in other respects. Many of the streptococci, which have been isolated from other sources, grow rather poorly upon the standard agar used in this study and it is possible that additional forms would have been found here had special media[17] been employed in the search.

The two non-spore-bearing yeasts were also unexpected forms but were so constantly present in large numbers in at least one udder as to be undoubted members of the udder flora. No spores were observed in these yeasts even when grown on gypsum blocks.

The greater number — 75 per ct.— of these forms were included in the genus Micrococcus. This is quite in accord with the experience of other students who have found udder cocci especially abundant.

There is an entire absence of spore formation among the organisms here described as representatives of the udder flora. This is not so unusual as would at first appear since 77 per ct. of these forms are cocci, among which spore formation is unknown.

Strict anaerobes are lacking in the above list since the technique employed would not have shown those which may have been present. Facultative anaerobes make up 20 per ct. of the list and the remaining 80 per ct. are classed as strict aerobes. This classification of the oxygen relation of the forms was made on the basis of their growth in the closed arm of the fermentation tube. Either this basis of classification is not accurate or the aeration within the udder is vastly different from what one would expect from the anatomy of the organ. If free oxygen is absent

[17] North, C. E. An agar gelatin medium. *Jour. of Med. Research* 20:359-363. 1909.

from the interior of the udder, as is commonly supposed, it is difficult to understand why the major portion of the udder flora consists of forms which cannot thrive under anaerobic conditions in laboratory cultures.

Gelatin is liquefied by 55 per ct. of the above list of germs, although the action is rather slow in most cases. It is ordinarily assumed that the ability to attack gelatin carries with it the ability to digest casein. This latter ability is noted from the appearance of tubes of inoculated milk. This method is crude and unsatisfactory in cases where the action is slow. In the present instance the digestion of casein was thus noted in only one-half of the groups where gelatin was liquefied. There is a strong probability that if sufficiently delicate tests of the action on casein had been applied the numbers digesting casein and gelatin would have been practically equal. The standard technique is much in need of improvement at this point. The most helpful suggestion for improving the technique is that of Hastings.[18]

With a large part of the udder flora provided with enzymes capable of digesting casein the milk within the udder should be attacked to a noticeable extent. In colostrum the changed condition of the milk is quite noticeable but so far as known this change has not been shown to be due to bacterial action. In the milk as normally drawn there is a measurable amount of water-soluble nitrogen and the extent to which these water-soluble nitrogenous compounds are derived from normal milk by bacterial action within the udder remains to be studied.

A considerable number of enzymes have been found in cows' milk in recent years. It remains to be shown to what extent these enzymes are secreted by the cow and how far they are elaborated by the bacteria which chance to be dwelling within the particular udder. In Bulletin 203[19] attention was called to an experimental

[18] Hastings, E. G. The action of various classes of bacteria on casein as shown by milk agar plates. *Cent. f. Bak.* II Abt. 12:590–592. 1904.

[19] Van Slyke, L. L., Harding, H. A., and Hart, E. B. A study of enzymes in cheese. N. Y. (State) Agr. Exp. Sta. Bul. 203. 1901. Also in Ann. Rpt. of same Station 20 (1901):165–193. 1902.

demonstration of the correlation between the germ content of quarters of an udder and the rate at which milk from these quarters underwent auto-digestion in the presence of chloroform. These results were not intended as a demonstration that all of the enzymes in milk were derived from bacteria but rather as a suggestion that bacterial enzymes within the udder are a factor which must be considered in studying true milk enzymes.

The fermentative activity of the udder flora is especially interesting. No visible gas is formed from dextrose, lactose, saccharose or glycerine when tested in the fermentation tube. This is not due to inability to attack these substances since acid was formed from dextrose by 89 per ct., from lactose by 70 per ct., from saccharose by 63 per ct. and from glycerin by 21 per ct. of the forms studied.

The technique employed in determining the reduction of nitrates has been already described. Nitrates were reduced by 59 per ct. of the forms but in no case was gas detected in the fermentation tube as a result of the reduction.

The records of color are particularly unsatisfactory in connection with these forms. While the difficulty is partly due to the tardy formation of slight amounts of coloring matter it is more largely due to the fact that the color is frequently salmon pink. Under varying conditions of age, light, moisture and substratum there is a tendency to classify cultures of the same organism under yellow, orange, red, brown and pink. The standard method of classification needs improvement at this point so that direct comparison can be made with standard test objects, using cultures of definite age and composition. The color given in the above table is that observed on the agar slope at the end of two weeks.

The action of the organism upon starch was judged by crushing fourteen-day potato cultures in a mortar and testing for starch with a dilute iodine solution. Where the action upon the starch was slight the fact was often best determined by adding the iodine solution to the fluid from the potato culture. The presence of the first products of starch digestion was shown by a wine color.

The lack of even the wine color was taken as evidence that the starch had not been attacked. This was the case with 80 per ct. of the cultures. Of the remainder the starch was practically all destroyed in 4 per ct. and 16 per ct. were classed as feeble. The separation of the cases where starch is attacked into two classes is unsatisfactory, since there was no available turning point between those where the action was barely perceptible and where it was practically complete.

Among the observed reactions which were not enumerated in Table I, the results with Gram stain are the most striking. With the exception of a single culture, No. 28, all of the isolated cultures were tested in this way and all but six gave positive reactions. The reaction of the single strain under No. 30 was variable and that of the single strains representing No. 1 and No. 2 was negative. One of the two strains under No. 7, one of the six strains under No. 12 and one of the three strains under No. 54 were also negative.

This proportion of Gram positive strains, 96 per ct., is surprisingly large and may be taken as one of the general characteristics of the udder flora.

Relative frequency of occurrence.— Some forms were observed in only a series of samples from a single cow while others were common in samples from various sources. In some cases the bacteria in a given quarter were few and the flora mixed while in others they were abundant and often consisted of practically a single form. These conditions can perhaps be best illustrated by tabulating the forms recognized in the case of the fifteen cows from the Station herd. These data are given in Table X.

TABLE X.

Date.	Cow.	R. F.	L. F.	R. B.	L. B.
2-7-11	Anna G.	29*			
2-8-11		29			
2-9-11		29			
2-7-11	Carey D. H...........		18, 15	61, 36	
2-8-11		15, 26	18, 15	15	15, 39
2-9-11		15	18, 15	16, 49, 71	39, 23

* The numbers given in this and the following tables are the culture numbers given in Table IX.

TABLE X (*continued*).

Date.	Cow.	R. F.	L. F.	R. B.	L. B.
2- 8-11	Carey F.		15	15	
2- 9-11				15	15, 63
5- 8-11				21	
5- 9-11				21	
5-10-11				21	21
5-11-11				21	
5-12-11			21	21	21
5-13-11				21	21
5- 8-11	Carey S.	49	49	12	12
5- 9-11		49, 3		12	
3- 8-10	Gertie F. No. 2.......	29			48, 17
3- 9-10				29	9, 29, 17
3-10-10			2, 29		29, 17
4-12-10		30			
4-13-10		30	24		
4-14-10			24, 30		30
5-11-10		29			
11- 9-10			24	30	24
11-10-10			24	24	24
11-11-10			24	17	24
12- 7-10			24		24
12- 8-10			24		24
12- 9-10			24		2
1-11-11				24	24
1-12-11				2	24
1-16-11				2	24
2-14-11				29, 25	27
2-15-11			25	29, 25	24
2-16-11		25	25	25	24
2- 7-11	Gertie F. No. 3.......	46	24		
2- 8-11			70 or 71		24, 70 or 71
2- 9-11		25, 70 or 71			
5- 8-11		33			
5- 9-11		33			
5-10-11		33			
5-11-11		33			
5-12-11		33			
5-13-11		33	33		
3- 2-11	Hammond	53	19	53	53
5- 9-11		53	19	53	53
5-10-11		53	19	53	53
5-11-11		53	19, 53	53	53
5-12-11		53, 56	19	53	53
5-13-11		53		53	53
2- 8-11	Hammond F. No. 2....	3			
5- 8-11					60
5- 9-11					60
5-10-11		21			60
5-11-11		60, 33		60	60
5-12-11					60
5-13-11					60
3- 8-10	Mabel S. F...........	29	29, 17	24, 17, 29	29
3- 9-10		29, 24	29, 17, 24		
3-10-10			17, 24		29
4-12-10		29, 24	29, 24	24	

TABLE X (*continued*).

Date.	Cow.	R. F.	L. F.	R. B.	L. B.
4-13-10	Mabel S. F...........	29	24	29	29
4-14-10		29	24	29	
5-10-10			24	29	29
5-11-10			24, 30	29	
5-12-10		29	24		
7-20-10		24, 29	29		29
7-21-10		24, 29	29	29	
7-22-10		29	29	24	
3- 8-10	Millie D.	29	6	29	65
3- 9-10					65, 6
3-10-10				24	29
5-31-10		6, 54	6, 52	6, 54	6
6- 1-10		6	6	6	6
6- 3-10				6	
6-20-10		52, 54	13	6	6
6-21-10		13	13	6, 59	6
6-22-10		52, 6, 24	52, 59	6	6, 24
11- 9-10		52, 17		6	6, 17
11-10-10		52, 17	52, 17	6	52
11-11-10		6	6, 2	6	2
12- 7-10		29, 54	29	29	6, 29
12- 8-10		54	54	29	54
12- 9-10		54, 29	54	29	54
1-11-11		54			54, 29
1-12-11		2, 29		29	54
1-16-11		58		6	2, 1
2-14-11		29, 27	29, 27	29, 27, 8	29
2-15-11		29, 27	29, 27	29, 27	29
2-16-11		29, 27	29, 27	29	29, 27
3- 8-10	Millie F.	24, 9	9		7, 29
3- 9-10		17, 24, 7			6, 30, 17, 24
3-10-10		7, 24	24	9	65
4-12-10		24, 53		6	17, 7
4-13-10		30, 52	52	7	30
4-14-10		24, 9	52	9, 24	65
5-10-10		7, 52	52	30, 29	65, 6
5-11-10		52	52	29, 30, 24	65
5-12-10		52	52, 65, 24	29	65, 24
7-20-10		53, 30		38	7
7-21-10				38	7
7-22-10		53	53	38	7
3- 8-10	Millie F. B. B........	24		29, 6	29, 24
3- 9-10			30	17	
3-10-10		9, 24		9, 30	65
4-12-10				9	29
4-13-10		24			
4-14-10		24	24	24, 30	65
2- 7-11	Millie G.	37	71		
2- 8-11		37			71
2- 9-11		37	20, 63		71
2-16-11		37			71
5- 8-11		19	19	19	71
5- 9-11		19		19	71
5-10-11		19		19	71
5-11-11		19		19	71

TABLE X (*concluded*).

Date.	Cow.	R. F.	L. F.	R. B.	L. B.
5-12-11	Millie G.	19		19	71
5-13-11		19		19	71
3- 8-10	Ruth F.	6			24
3- 9-10					24
3-10-10			17, 66	9, 66	24, 9
5-26-10			66		24
6-20-10					24
7-21-10		9	20	17, 66	24
7-22-10		6	66	6	24
11- 9-10		6	6	6, 17	24
11-10-10		6, 24	6	6	24
11-11-10		6	24	6	24
12- 7-10				6	24
12- 8-10				6, 17	24
12- 9-10				6, 17	24
1-11-11			2	6, 24	24
1-12-11				24	24
1-16-11				6, 29	24
2-14-11				29, 27	24, 27
2-15-11				29, 27	24, 27
2-16-11			28	29, 27	24, 27
4-12-10	Ruth S.	30		52, 30	
4-13-10		30		52, 30	
4-14-10		30, 29		52, 13	13
5-10-10		52		52, 30	13, 9
5-11-10		9		13	13, 7, 9
5-12-10		7, 9		13, 52	13, 7, 9
7-20-10		66		66	66
7-21-10		66, 30		66	66
6-22-10		66		66	66

The above table shows that 45 groups of organisms were recognized in 750 samples representing 15 cows. The frequent failure to classify the organisms, particularly in the front quarters, was largely due to the small numbers present and the consequent uncertainty as to whether the colonies on the plates represented real members of the udder flora. Occasionally the attempt at classification was omitted because of the mixed character of the growth and suspicion that the sample may have suffered from some unknown contamination. A few of the vacancies are due to the loss of type cultures before their study had been completed. In a fair proportion of cases miscellaneous colonies appeared upon the plates. They were not included in the classification because, as already explained, every effort was directed toward restricting the classified forms to members of the true udder flora.

Ruth S. gave no milk from the left front quarter of her udder.

It will be noted that in one or more quarters of many of the cows a single organism persisted for long periods and during this time it was the predominating organism in most cases. These observations offer the strongest evidence for the inference that such forms have so adapted themselves to the conditions found in the interior of the udder as to be considered fairly permanent inhabitants. Such being the case it is hard to understand why they do not attain much larger numbers than have been observed during these studies.

It will also be observed that in those cases where a given form is abundant in one quarter it is at least occasionally met in the milk from the other quarters. This may be explained on the basis that it was really present all of the time but was missed in the cultures. While this may have been the case in some instances, the use of one cubic centimeter sample of milk at each examination should have reduced this difficulty very markedly since an organism which is present in a proportion of less than one organism to a cubic centimeter of milk is surely not very abundant. On the other hand, the spreading of the germs from one quarter to another may have been connected with the ordinary milking process. While it is the aim of most milkers to avoid wetting the hand, they are frequently moistened, especially in the act of stripping. With hands thus moistened the infection of the exterior of one teat with the germs from the other quarter is relatively easy.

The yeast culture was so abundant and so constant in the left back quarter of Millie G. as to put at rest any doubt as to its being a member of the udder flora.

While the persistence of a given group in a single udder, as well as its distribution among the various quarters of an udder, is well shown in Table X, the distribution of the various groups among these fifteen cows is better shown in Table XI.

TABLE XI.— DISTRIBUTION OF OBSERVED BACTERIA AMONG THE UDDERS OF DIFFERENT COWS.

Anna G.	Carey D. H.	Carey F.	Carey S.	Gertie F. No. 2.	Gertie F. No. 3.	Hammond No. 2.	Hammond F. No. 2.	Millie D.	Millie F.	Millie F. B. B.	Millie G.	Mabel S. F.	Ruth F.	Ruth S.
....	....	....	....	2	....	....	....	1	....	....	....	....	....	....
....	....	....	3	....	....	....	3	2	....	....	....	....	2	....
....	....	....	....	....	....	....	....	6	6	6	....	....	6	....
....	....	....	....	....	....	....	....	....	7	....	....	....	....	7
....	....	....	....	....	....	....	....	8	....	....	....	....	....	....
....	....	....	....	9	....	....	....	....	9	9	....	....	9	9
....	....	....	12	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	13	....	....	....	....	....	13
....	15	15	....	....	....	....	....	....	....	....	....	....	....	....
....	16	....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	17	....	....	....	17	17	17	....	17	17	....
....	18	....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	19	....	....	....	....	19	....	....	....
....	....	....	....	....	....	....	21	....	....	....	20	....	20	....
....	....	21	....	....	....	....	....	....	....	....	....	....	....	....
....	23	....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	24	24	....	....	24	24	24	....	24	24	....
....	....	....	....	25	25	....	....	....	....	....	....	....	....	....
....	26	....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	27	....	....	....	27	....	....	....	....	27	....
....	....	....	....	....	....	....	....	....	....	....	....	....	28	....
29	....	....	....	29	....	....	....	29	29	29	....	29	29	29
....	....	....	....	30	....	....	....	....	30	30	....	30	....	30
....	....	....	....	....	33	....	33	....	....	....	....	....	....	....
....	36	....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....	....	37	....	....	....
....	....	....	....	....	....	....	....	....	38	....	....	....	....	....
....	39	....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	46	....	....	....	....	....	....	....	....	....
....	....	....	....	48	....	....	....	....	....	....	....	....	....	....
....	49	....	49	....	....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	52	52	....	....	....	....	52
....	....	....	....	....	....	53	....	....	53	....	....	....	....	....
....	....	....	....	....	....	....	....	54	....	....	....	....	....	....
....	....	....	....	....	....	56	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	58	....	....	....	....	....	....
....	....	....	....	....	....	....	....	59	....	....	....	....	....	....
....	....	....	....	....	....	....	60	....	....	....	....	....	....	....
....	61	....	....	....	....	....	....	....	....	....	....	....	....	....
....	....	63	....	....	....	....	....	....	....	....	63	....	....	....
....	....	....	....	....	....	....	....	65	65	65	....	....	....	....
....	....	....	....	....	70	....	....	....	....	....	....	....	66	66
....	71	....	....	....	71	....	....	....	....	....	71	....	....	....

The numbers given in the above table correspond to the culture numbers used in the list of udder bacteria in Table IX and it is

believed that these 45 groups can be safely considered as true members of the udder flora.

It is seen that Nos. 6, 9, 17, 24, 29 and 30 were obtained from the udders of four or more of the 15 cows. Expressed in the older nomenclature the first two of these are *Bacterium lactis non-acidi,* the next two are variant strains associated with *Bacterium lactis varians,* No. 29 is *Bacterium lactis albidus* and the last is also *Bacterium lactis varians.* Of these cultures Nos. 29, 24 and 17 were the most common, having been found in 8, 7 and 6 udders, respectively.

The cultures isolated from the samples obtained on a single occasion from another herd cannot all be assigned to the udder flora with the same assurance as those given above, but the certainty of their having been derived from this source is increased in proportion to the number of udder samples in which they were observed.

The culture numbers noted in the 184 samples from the herd of Mr. A. G. Lewis and the number of samples in which each was found are given in Table XII.

Table XII.—Frequency of Isolation of Udder Forms from 184 Samples.

Culture No.	Times found.	Culture No.	Times found.	Culture No.	Times found.
4	2	32	16	51	1
5	1	34	2	**52**	1
10	2	35	3	**53**	5
11	1	40	5	**54**	2
12	6	41	6	55	2
13	1	42	5	57	1
14	1	43	1	62	7
20	16	44	1	64	4
22	6	45	6	67	3
24	5	47	3	69	1
29	20	49	7	70	1
31	4	50	1		

The culture numbers given in bold face in the above table are those previously noted in Table XI. Finding them in the udders in this separate herd, many members of which had been recently imported from the Island of Guernsey throws some light upon their international distribution. Of the forms not previously encountered a number of them occurred in so many samples there can be no doubt of their being true members of the udder flora. The most doubtful forms are those found in but one or two samples. They would have been excluded from the list had any suspicious circumstance been observed in connection with their isola-

tion. As matters stand they cannot be accepted as members of the udder flora with the same feeling of certainty which accompanies the other forms.

Temperature relations.— By referring to Table X it will be seen that certain numbers in the table are printed in bold face type, which signifies that these forms did not appear on the plates kept five days at room temperature but did appear after these plates had been held two additional days at 37° C. This would indicate that these particular forms had become so habituated to the blood heat of the cow as to grow rather poorly at lower temperatures.

The distribution of this class of organisms is also interesting. They are lacking in Carey F., Hammond F. No. 2 and Millie F. B. B., make up the entire flora in Hammond No. 2 and are present in varying proportions in the other udders.

A partial explanation of this temperature relation is found by studying the udders in which there is a mixed result, as with Millie D. Here the examinations extended over a year and it will be observed that the additional growth at 37° C. was mainly during the colder portions of the year. While the temperature of the room in which the plates were held for five days was maintained at approximately 70° F. during the day the temperature fell sharply at night with the result that the growth of these udder germs was markedly checked. These irregular results due to incubation at room temperature emphasize the weakness of this procedure and the need of a low temperature incubator such as has been constructed and will be described in a forthcoming bulletin. (Technical Bulletin No. 29.)

It is clear, however, that the above is not an entire explanation of this temperature relation since the tests with Carey F., where the high-temperature-loving forms were absent and with Hammond No. 2, where they made up the entire flora, were made simultaneously.

RELATION OF UDDER FLORA TO MILK PRODUCTS.

Practically the only extended study of milk products which is available for direct comparison is that of the flora of cheddar cheese as given in Technical Bulletin 8.[20] At that time the Society

[20] Harding, H. A., and Prucha, M. J. The bacterial flora of cheddar cheese. N. Y. (State) Agr. Exp. Sta. Technical Bulletin 8. 1908. Also in Ann. Rpt. of same Station 27 (1908): 48–120. 1909.

group number contained only eight places instead of ten as at present.

Making due allowance for this difference in the basis of classification 15 of the 71 groups from the udder are probably comparable to those found in cheddar cheese. It is noteworthy that none of these 15 groups are among those most abundant in the udder and only six of them, Nos. 52, 53, 54, 59, 60 and 63 were among the groups given in Table XI.

Perhaps the best known of these 15 groups are Nos. 40 and 69 which are typical organisms of sour milk. It should be stated that neither of these organisms was found in any of the more than 700 samples from the Station cows. On the other hand No. 40 was found in five and No. 69 in one of 184 samples taken from another herd. The fact that this large number of samples was taken in a strange barn at a single milking suggests the possibility of accidental contamination. Nothing was observed in connection with the sampling to suggest contamination nor was it evident from the colony growths aside from the unusual physiological properties of the organisms present. The finding of such acid-producing organisms in the udder is not new, similar observations having been made by von Freudenreich,[21] Gorini,[22] and Harrison.[23]

It should be noted in this connection that it was a common practice, in the herd in which these acid organisms were recovered from the udders, to permit the cows to be suckled for varying lengths of time by calves. Esten[24] has pointed out that the mouth of the cow is a habitat of acid organisms and it is possible that the mouth of the calf was the source of these acid organisms recovered in the udder samples.

A more detailed study of the later history of milk and its products must be made before the influence exerted by the udder flora

[21] v. Freudenreich, Ed. Ueber die Bakterien in Kuheuter und ihre Verteilung in den verschiedenen Partien des Melkens. *Landw. Jahrb. Schweiz.* **18**:401–427. 1904. Also given in Sur les bactéries de la mamelle de la vache et sur la manière dont elles sont réparties dans les différentes portions de la traite. *Rev. gen. Lait.* **3**:416–425; 440–448; 462–473. 1904.

[22] Gorini, C. Sui Bacteri dei dotti galattofori delle vacche. *Atti della R. Accademia dei Lincei*, Series 5ª Rendiconti, **11**: (2nd Semestre): 159–165. 1902.

[23] Harrison, F. C., and Savage, A. The bacterial content of the normal udder. *Rev. gen. Lait* **9**:121–131. 1912.

[24] Esten, W. M. Bacterium lactis acidi and its sources. Conn. (Storrs) Sta. Bul. 59. 1909.

upon the later germ life in the milk can be definitely stated. So far as the data are now available the germ life in the udder does not maintain itself very successfully in the competition which it meets after being drawn. This is to be expected on account of the sudden change in environment to which it is subjected. The oxygen within the udder must be scanty if not absent and the temperature is above 37° C. After being drawn the oxygen supply is markedly increased while the temperature is usually rapidly decreased.

While the udder flora as a whole probably does not persist in the milk after it is drawn, some portions of it may do so. The observations on cheddar cheese as quoted above make it probable that a number of forms actually do persist for a considerable period. Gorini[25] has ascribed to the acid-forming liquefiers of the type of *M. lactis varians* a leading role in the ripening of hard cheese. If this supposition is correct, it is evident that the udder flora exerts a marked influence upon this important industry.

It should not be assumed that with the disappearance of the udder forms their influence upon the milk is entirely dissipated. The work of Marshall and his students[26] has shown that even after the total destruction of a given form it may leave such an impress upon the milk as to affect markedly the growth of the organisms which succeed it.

It should also be remembered that the present study has not taken account of the anaerobic flora of the udder, if such exists. The natural lack of aeration in the udder is so great that the conditions there would seem ideal for the development of a distinctive anaerobic flora.

It is much to be regretted that this study has not been more complete along a number of lines but the removal of each of the authors to other fields of activity has at least temporarily halted the investigation.

CONCLUSIONS.

Many of the forms found in the udder are so accustomed to relatively high temperatures that they do not develop satisfactorily at ordinary room temperatures. This fact should be con-

[25] Gorini, C. Ueber die saure-labbildenden Bakterien der Milch. *Cent. Bak.* II Abt. 8:137–140. 1902.

[26] Marshall, C. E. Additional work upon the associative action of bacteria in the souring of milk. *Cent. Bak.* II Abt. 12:593–597. 1904.

sidered in connection with any study of the milk flora but its importance is probably greatest in samples of freshly drawn milk.

Bacteria are most abundant in the first few streams or foremilk, are distinctly less abundant during the main portion of the milking and again become more abundant in the strippings. As a result of this relationship a fairly close approximation of the germ content of the entire flow of milk can be obtained by examining the strippings. Samples taken at this stage of the milking are especially satisfactory as a basis for study of the udder flora.

The germ content was found to be unequally distributed in the udder, the back quarters having about three times as many germs per cubic centimeter as the front quarters. The average of 1,230 samples was 428 per cc., but as the back quarters furnish more milk than the front the average germ content in milk which can be ascribed to the udder content will be approximately 500 per cc. Only 8 per ct. of the samples had a germ content of over 1,000 per cc.

The connection between the period of lactation and the germ content was not very marked. The colostrum showed a slightly higher and the milk of the twelfth month a slightly lower content than the intervening periods.

The age of the cow likewise was not found to exert any appreciable effect upon the germ content of the udder.

The kinds of organisms present in over 900 samples of milk were studied and 71 groups described as members of the udder flora. No organisms producing spores and no motile forms were found. Seventy-five per ct. of the forms were micrococci but only two streptococci were isolated. The need of free oxygen was so great that 80 per ct. of the forms were not able to produce turbidity in the closed arm of the fermentation tube. Gelatin was liquefied by 55 per ct. of the forms and digestion of milk was evident in cultures of about one-half of these forms, the remainder probably liquefying too slowly to be determined by this comparatively crude method. No gas was formed in fermentation tubes in the presence of dextrose, lactose, saccharose or glycerin but acid was formed in percentages varying from 89 to 21 per ct. of the forms with the different sugars. Nitrates were reduced by 59 per ct. of the forms and starch was attacked by 20 per ct. The Gram stain was positive with 96 per ct.

AN EFFICIENT ELECTRICAL INCUBATOR.*

H. JOEL CONN AND H. A. HARDING.

SUMMARY.

1. The ordinary form of gas-heated incubator is unsatisfactory because of the danger of fire and the difficulty in securing constant temperatures below that of the room.

2. The difficulty has been avoided by constructing incubators insulated with cork-board, heated by electricity, and one of them cooled by the drip-water from a refrigerator.

3. The cost of constructing four incubators, each of 7 cu. ft. capacity, and a refrigerator of 25 cu. ft. capacity, was $382.

4. The cost of maintenance, with the incubators at 18°, 25°, 30°, and 37° C. respectively, and the refrigerator at 7° to 10° C., is well under $40 per year.

INTRODUCTION.

One of the necessities for careful bacteriological work is a means of incubating cultures at various temperatures. Temperatures above that of the room are easily secured, but satisfactory incubators which remain constant at lower temperatures are almost unknown. For this reason it seems worth while to describe a piece of apparatus providing for incubation at both high and low temperatures, which has been used here for a year with entire satisfaction. It consists of a refrigerator and four incubators, and is heated by electricity.

CONSTRUCTION OF REFRIGERATOR AND INCUBATORS.

MATERIALS.

In constructing the refrigerator and incubators the following materials were employed.

Lumber. The outer case was built of matched, seven-eighths-inch, kiln-dried oak. In order to necessitate as few battens as possible, and to furnish a smooth inner surface on which to lay the succeeding layers of insulating material, strips of this oak were glued together edge to edge, alternating the grain so as to prevent warping. Thus each side of the case is essentially a single board. To protect the wood from the action of dampness the inner surface was finished with three coats of paint, while the outer was filled and varnished.

* Reprint of Technical Bulletin No. 29, March, 1913.

Well seasoned white pine was employed for an inner lining of the refrigerator. This was given three coats of paint on each side and both tongue and groove were freshly painted just before laying.

Posts made of seven-eighths-inch whitewood glued up to prevent warping were used for door-jambs and for the framework of the doors. Paint was used to waterproof these posts on all surfaces except those edges where the doors and jambs were to come in contact. As neither paint nor varnish could be used there, and as oil alone would cause the wood to swell, these edges were treated with paraffin. The paraffin was driven into the wood by means of a hot iron. The result of this treatment, in protecting from moisture and in preventing the door and jamb from sticking together, has been entirely satisfactory.

Half-inch seasoned cherry was used for the incubator shelves and their supports, and seven-eighths-inch seasoned oak for the ice-rack and ice-fenders in the refrigerator. Since these were to be exposed to considerable moisture, they were thoroughly impregnated by stewing the finished pieces for at least thirty minutes in melted paraffin. The oak ice-rack, after this treatment, although it stands constantly in water, has not warped in the slightest; but in the shelves of the 18° incubator, which contains a saturated atmosphere, some warping has occurred.

Throughout the construction, every piece of lumber was treated over its entire surface with paint or other substance designed to prevent the entrance of moisture.

Insulating material.— Cork-board[1] was the main provision for insulation. This is a very efficient insulating material, and since it can be cut accurately by either saw or bit, lends itself readily to close construction. The sheets of cork-board used were four inches thick, and one foot wide and three feet long. A single layer of this thickness has proved satisfactory; but two layers of three-inch stuff, laid with broken joints, would undoubtedly have furnished better insulation, thus reducing both the consumption of current and the heat transference from chamber to chamber. The joints between the sheets of cork were cemented with Nonpareil Waterproof Cement.[2] This cement has served its purpose perfectly; but it is so expensive that some other binding substance might prove cheaper and more satisfactory.

Metal.— Heavy zinc was used in lining the refrigerator to protect the walls from moisture and from mechanical injury.

Shelves, shelf supports, and drip-pan, in the refrigerator, were made of galvanized iron.

Brass pipe was used for the drain to the refrigerator and the cooler of the 18° chamber. Its external diameter is at most places one inch, but a short length is of inch-and-a-quarter pipe. The use

[1] Nonpareil Corkboard, obtained of Armstrong Cork Co., Pittsburg, Pa.

[2] Obtained of Armstrong Cork Co.

of brass is to keep down fungus growth within the pipe, not so much because of the toxic action of the brass itself, as because copper sulphate can be added at intervals without causing electrolytic action.

In each of the incubators steel bars were used to support the upper layers of cork. Strips of wood impregnated with paraffin, however, having lower conductivity to heat, would undoubtedly have caused less heat transference from chamber to chamber.

Hinges and door clasps were of brass.

Miscellaneous materials.— Between the oak casing and the cork-board of both refrigerator and incubators was laid the best obtainable quality of building paper.

In the incubators a Nonpareil Finishing Cement[3] was applied directly to the inner surface of the cork. The cement was covered with three coats of paint to secure a harder and more waterproof surface. This cement was used, instead of ordinary Portland cement, because it was understood to be less liable to crack. In the 37° incubator, however, cracks have formed; and as this cement sets slowly and never becomes very hard, its use is hardly to be recommended.

CONSTRUCTION.

The dimensions and main details of construction of the refrigerator and incubators are shown in Figs. 2–4. Fig. 2 is a front elevation, while Figs. 3 and 4 are sections to show the construction in detail. The present description is merely supplementary to these figures.

Construction of refrigerator.— The refrigerator is 35x40x81 inches over all and has a capacity of 25 cu. ft. These dimensions are not ideal, but were determined by the space available. Had space permitted, a broader ice-chamber, which could better accommodate an ordinary cake of ice, would have been more satisfactory.

In order to secure rigidity the outer case of oak was built with box headings at the top and bottom, as shown in Fig. 3, carefully breaking all the joints and laying the battens in fresh paint. Inside these headings, after building paper had been tacked over the oak, the four-inch layer of cork was fitted snugly into place. The headings were then covered with matched pine. The building paper and cork-board were next fitted closely around the back and sides. This layer of cork was covered in turn with seven-eighths-inch white pine. The resulting box, 23x28x69 inches, was lined with heavy zinc, the angles flushed with solder, and the front edge of the zinc nailed closely to the front edge of the pine lining.

To support the drip-pan and the ice-rack which lies in it, a wooden shelf was built 20 inches from the top of the chamber. In front

[3] Nonpareil High Pressure Finishing Cement, obtained of Armstrong Cork Co.

and in back of this shelf a two-inch space was left to permit circulation of air.

The galvanized iron drip-pan has a brass outlet secured by gaskets and lock-nuts in such a manner as to project about an inch above the bottom of the pan. This outlet extends less than an inch below the pan, and slips snugly into the brass pipe which conducts the water through the wall of the refrigerator into the

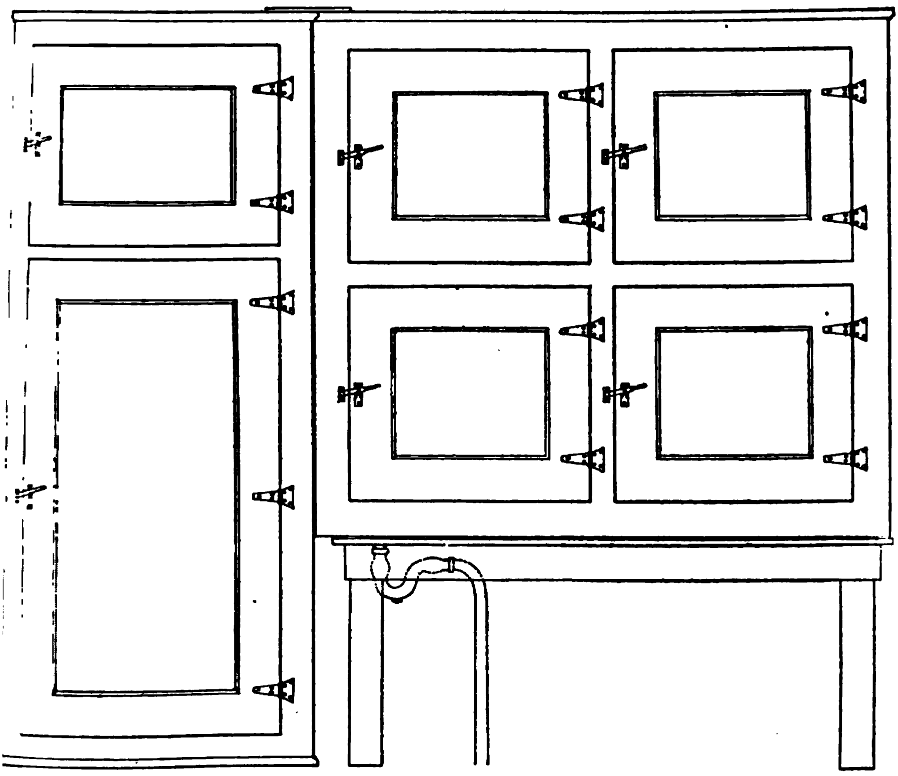

Fig. 2.—Front Elevation of Refrigerator and Incubator.

incubator. The shortness of the outlet and its slip-joint allow the pan to be easily removed for cleaning or inspection; while the protrusion of the outlet pipe above the bottom converts the drip-pan into a sedimenting chamber to remove the solids derived from the ice. This arrangement is to protect the drainage system from clogging and to facilitate cleaning in case clogging should occur.

From Figs. 2 and 4 it can be seen that the front of the refrigerator consists wholly of doors and door-jambs. The outer layer of the doors is of oak, glued up with a panel effect on the outside, but smooth and flush on the inner surface. The edges of the doors and the jambs are beveled on all sides in order to secure a close fit. The central portion, making up about two-thirds of the entire door,

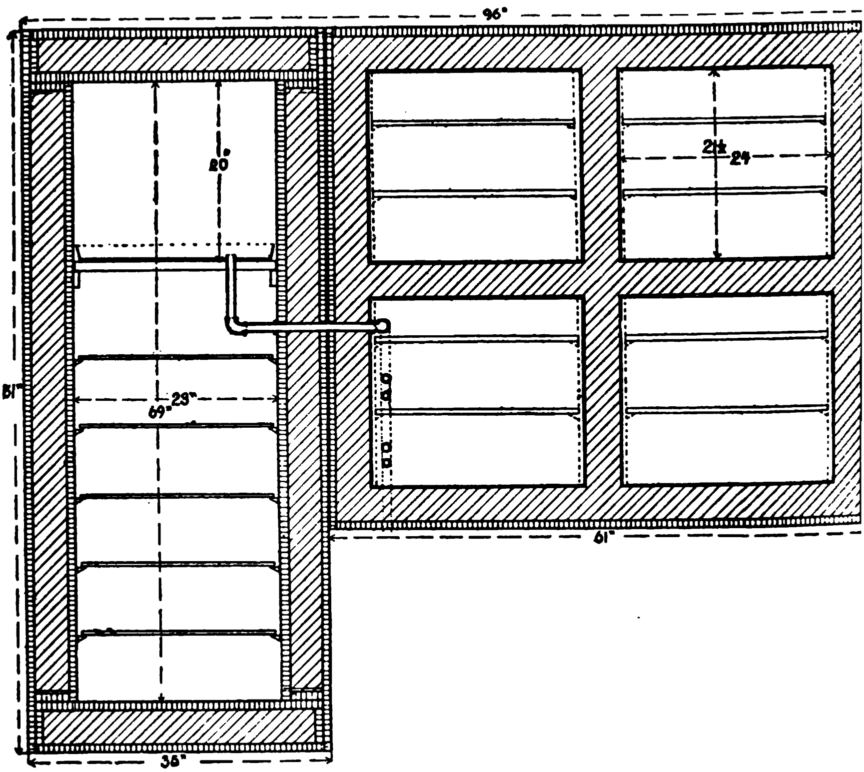

FIG. 3.—VERTICAL SECTION OF REFRIGERATOR AND INCUBATOR.

(Diagonal hatching indicates cork-board; other hatching, wood.)

is a layer of four-inch cork-board, the inner surface of which is protected by a sheet of zinc nailed securely to the whitewood edges.

The upper door is for admitting ice. The inner edge of the threshold is covered with a strip of galvanized iron and is slightly lower than the top of the ice-rack. Thanks to this device a large cake of ice, raised by rope and pulley, can be swung into place without

damaging the threshold. As a further protection from the ice, the walls and inside of the door of the ice-chamber are provided with fenders of oak impregnated with paraffin. These fenders, moreover, prevent the ice from slipping out of place, so that all the water from its melting falls into the drip-pan. The ice-chamber readily accommodates 200 pounds of ice.

The lower door opens into the storage chamber. Just inside of this door two galvanized iron doors are hung one above the other. One of these is shown in section in Fig. 4. They are designed to minimize the loss of cold air when access is desired to the upper shelves of the storage chamber. The storage chamber contains

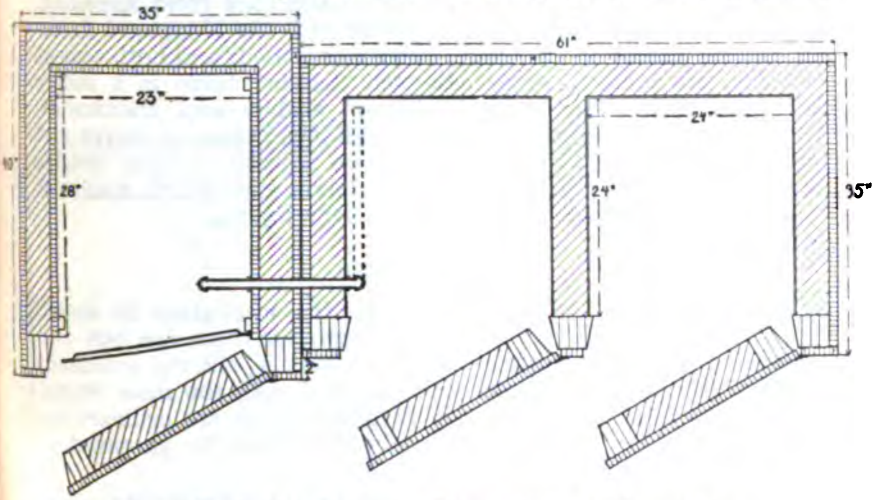

FIG. 4 —HORIZONTAL SECTION OF REFRIGERATOR AND INCUBATOR.

(Diagonal hatching indicates cork-board; other hatching, wood.)

approximately $17\frac{1}{2}$ cu. ft. The five shelves within it, as shown in Fig. 2, are supported by runners of angle iron and are easily removed. This arrangement of shelves affords about 27 sq. ft. of shelf space. One of the shelves is designed for cooling gelatin plates.

Construction of incubators.— As shown in Figs. 2–4, the four incubators, each of 7 cu. ft. capacity, are built together as a single unit. This arrangement, as well as the shape of the chambers, was made necessary by the space available; but as a result the walls are so thin as to allow some heat transference from incubator to incubator, and the chambers so high as to bring about a difference of one or two degrees in temperature between top and bottom. Had each chamber been built separately, the insulation would have been more complete and the incubators, at the same time, would have

been portable; while if they had been broader and lower (15 inches high, possibly) with one shelf instead of two, the temperature variation between top and botton could probably have been disregarded.

The details of construction are similar to those of the refrigerator except for the omission of pine lining and of the accessories for supporting the ice.

The walls separating the individual incubators consist solely of four-inch cork-board, cemented together, the horizontal partitions having, on their under surface, two thin bars of steel for support. The construction is further strengthened by a steel rod passing through the cork-board from the middle of the front to the middle of the back, serving to prevent the front and back from spreading. The inner surfaces of the cork are covered with the Nonpareil finishing cement, except on the doors, where zinc is used; and both cement and zinc are painted white. In each chamber there is a cherry framework around the walls to support shelves and thermostat. The two shelves are built of slats of half-inch seasoned cherry and rest on metal pegs so that they can be adjusted to any height. A fender about an inch in front of the thermostat, which stands at the middle of the back wall, protects it from injury.

HEATING SYSTEM.

The arrangement of the circuits in the incubators is shown diagrammatically in Fig. 5. In each incubator there are but two essential pieces of apparatus, the thermostat T, and the resistance wire R. The four incubators are connected with the main circuit through the fuses FF, and are in parallel, just as are ordinary incandescent lights. Within the chambers, however, the thermostats and heaters are in series.

The thermostat is the most important part of the heating system. The four thermostats were designed and made by Prof. C. H. Tower of the electrical engineering department at Cornell University. They are wholly of metal, with rigid bases, and can be firmly secured in any desired position. The sensitive part of each is a strip of copper and iron about twelve inches long. As this type of thermostat interrupts the current when over-heated and can be wired into the main circuit, power is used only when it is needed for the production of heat. This results in economy. The initial cost, moreover, of all four thermostats was only $12.

The heaters are of Nichrome wire[4] No. 32, having a diameter of 0.008 inch. In each chamber are two lengths of wire, each about 20 feet long, shown in Fig. 5 by the zig-zag lines RR. In the incubators, however, the turns of wire are in a horizontal instead of a vertical plane, and each length is supported beneath a shelf. As shown in Fig. 5, the two lengths of wire are not arranged the same

[4] Obtained of Driver-Harris Wire Co. of Harrison, N. J.

in all four chambers; for temperatures above 30° they are in parallel, but for temperatures as low as 25° they are in series. This arrangement allows four times as much current to pass through the heaters for the higher temperatures as through those for the lower ones. With stationary shelves this arrangement of the wires would have presented no difficulties; but it was desired in this case to have removable shelves. To accomplish this the ends of the heating wires are fastened to copper plates at the edges of the shelves; and when the shelves are in position these plates are in contact

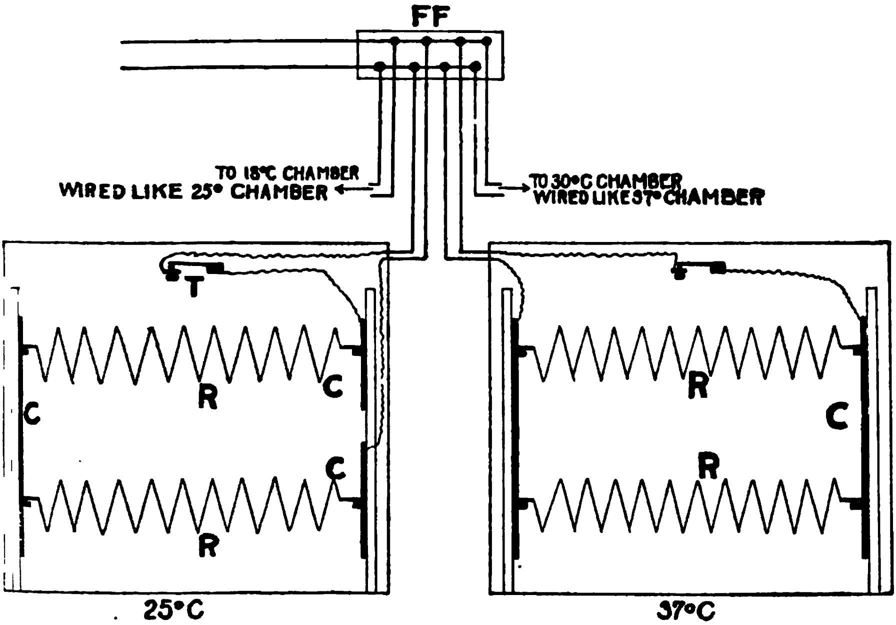

Fig. 5.—Arrangement of Circuits.

T, thermostat; R, resistance wires; C, copper plates; FF, Fuses.

with the metal pegs that support the shelves. In each chamber two of the supporting posts CC are faced with copper; and as this copper is connected by wire with the thermostat and the main circuit, the current passes through the heating wires whenever the thermostat is closed. This arrangement of the heaters places them well out of the way and distributes them so as to prevent overheating at any part of the chamber. To avoid the difficulty of wiring beneath the shelves, the heaters might have been placed vertically at each side of the chamber. This lateral arrangement, although not tried out here, might prove fully as satisfactory.

In placing uninsulated wire so close to paraffined wood, there might seem to be some danger of fire. This danger, however, is more apparent than real. The wire used offers so much resistance that even though the thermostat should fail to break the circuit the temperature would not become extremely high; and if the improbable should happen and a sufficiently high temperature should be reached, the renewal of oxygen through the cracks of the doors would not be sufficient to support combustion. Even though it were, there would be nothing to burn but the inside woodwork, for cork-board is incombustible. As a further protection, however, each length of wire has been broken at one point and soldered together again in such a way that if the solder melts the two ends of wire will fall apart and break the circuit. Using these precautions, there has been no indication of the slightest danger from fire during a whole year of use. Compared to the danger of fire from a gas incubator the fire risk here is wholly negligible.

Each chamber is connected with the main circuit by means of what is called deck cable. This double-wired cable passes through a close fitting hole in the back of each chamber, where it is held in place by means of cement (the same as used for the cork-board), which was smeared upon the cable before drawing it into its final position. Outside the incubators, the only electrical appliance is the fuse-box FF.

All external resistance is avoided; because with a voltage of 110 or 120 sufficient resistance is furnished by the heating wires to prevent the passage of too powerful a current. The advantage of this arrangement is obvious, for it allows practically all the energy to be utilized within the chamber. The avoidance of external resistance and the good heat insulation insure a low cost for maintenance.

COOLING SYSTEM.

There are three principal methods of cooling ordinarily used in low temperature incubators. The first is a circulatory system of either pure water or brine; the second is by means of a continually flowing stream of cold water; while the third method is employed in the Panum type of incubator where cooling is effected by direct conduction from an ice-chamber through thin, uninsulated walls. The first of these three, as it often requires an extra thermostat, is quite complex; and the last method is very inaccurate; while the second, provided a stream of sufficiently cold water can be obtained, is both simple and accurate. Because of the difficulty in obtaining such a stream during hot weather, this method is slightly modified in the present incubator by using as a cooling medium the drip-water from the ice-chamber.

The 18° chamber alone is cooled. The cooling apparatus consists of a one-inch brass pipe through which flows the drip-water

from the refrigerator. The total length of pipe is 11 ft., and it passes four times across one side of the chamber. Fig. 6 is a diagrammatic sketch of the wall of the chamber which bears this cooler. At A is a screw union securing the cooler to the pipe which enters from the refrigerator. At B is a slip-joint where the cooling pipe rests in the drain. C is a stand pipe of one-and-a-quarter-

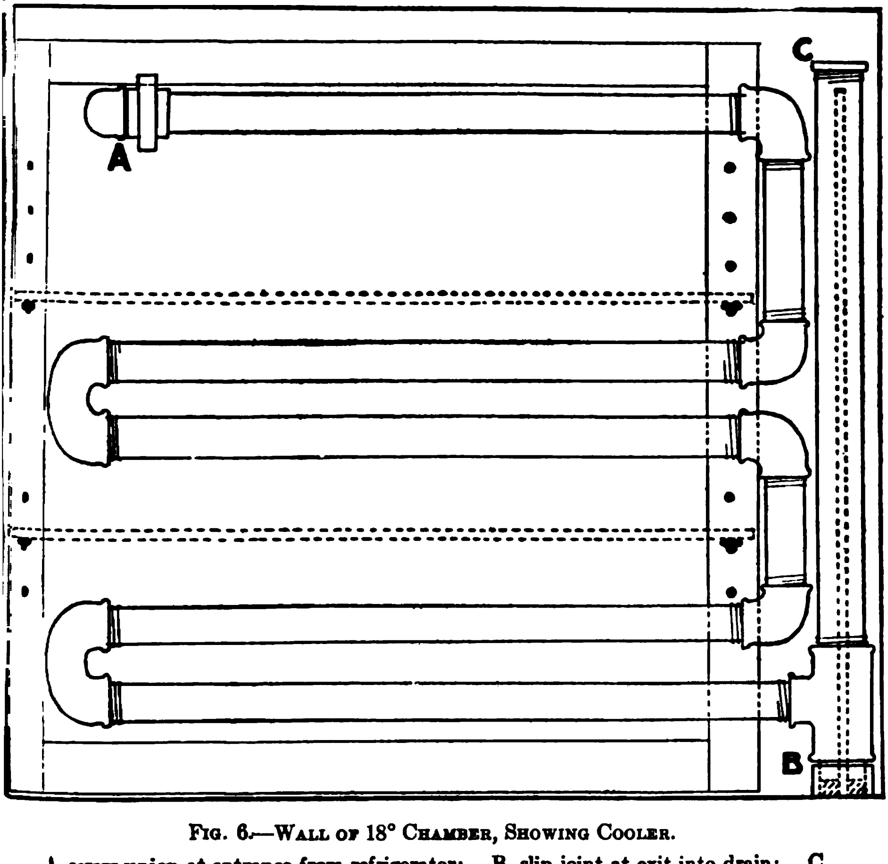

FIG. 6.—WALL OF 18° CHAMBER, SHOWING COOLER.
A, screw union at entrance from refrigerator; B, slip-joint at exit into drain; C, stand-pipe.

inch brass tubing. Within the stand-pipe is a glass tube passing through a rubber stopper which fits tightly into the outlet at B, thus forcing the water to run out through the tube. By changing the length of this glass tube the amount of cold water retained within the cooler is easily regulated. As the cooler is attached only at the screw union A and the slip joint B, it is readily removed for cleaning.

The drain from this cooling pipe, as shown in Fig. 1, is connected with the main drain of the building through a trap. There is a space of but five inches between the water level of the trap and the point where the pipe leaves the incubator. This is an important point; because the air within the pipe may be warmed for this short distance and carry the heat into the incubator through convection. The longer the distance, therefore, between the trap and the incubator, the greater will be this warming effect upon the chamber.

It has been found in practice that when the glass tube is adjusted to keep the overflow from the cooler almost as high as its entrance into the chamber, and the pipe is full of water, the temperature of the chamber, even without the use of a thermostat, remains fairly constant at 17°–18°. If a temperature of 20° were desired, the outlet from the cooling pipe could be lowered by shortening the glass tube, allowing less cold water to stand inside the chamber. The regularity effected by the cooler is surprising; but it is undoubtedly explained by the fact that the warmer the weather the faster the ice melts and the more cold water is supplied to the chamber. Still greater regularity is secured by the use of thermostat and heater as well as the cooler, which keep the temperature constant at times when the cooler alone would bring it below the desired point.

The cooler keeps the temperature of the incubator below 18° except when the room temperature exceeds 28°. Its failure at such times might have been prevented by building a larger ice chamber or possibly by constructing the cooler with more radiating surface. In this climate, however, these high temperatures are so rare that the arrangement described has given no serious trouble.

The chief objection to using the drain pipe for cooling purposes is its liability to clog with sediment or with the fungus growth that often collects in drains of ice-chests. The sediment, however, is kept out by having the overflow from the drip-pan, as already mentioned, half an inch above its floor; and the fungus growth is largely prevented by putting a little copper sulphate into the pipe at intervals. The trouble with clogging, indeed, has been very slight. During the ten months of service the pipe has been cleaned out but four times; and after the practice was begun of adding the copper sulphate as often as every ten days, four months passed without the necessity of cleaning. The ease, moreover, with which the whole cooling pipe can be disconnected makes it a moderately simple matter to remove it when it does need cleaning.

This form of cooler, indeed, has proved entirely satisfactory. It is more accurate than the Panum type, and more simple than a circulatory system. It also has an advantage over the ordinary incubator cooled by a non-circulating stream of water in that its cooling medium is especially abundant at the season when it is most needed.

COST.

Cost of construction.— If no allowance be made for the time spent by members of the Station staff in supervision, the cost of construction was as follows:

Carpenters (labor)	$134 00	Other electrical fittings	$15 00
Cork-board	45 00	Zinc and galvanized iron fittings (and labor)	34 00
Cement for cork-board	11 50	Hinges, door-clasps, screws, nails, etc.	12 00
Lumber	67 90		
Mason (labor and materials)	17 00		
Finish (paint, varnish, etc.)	10 00		
Plumbing	23 00	Total	$381 75
Thermostats (and heating wire)	12 35		

Cost of maintenance.— The incubator has proved especially economical in service. The only cost of maintenance has been for ice and electricity. Ice consumption is very moderate. During the spring, while the room temperature averaged 21°, it was found that 216 lbs. of ice lasted 12 days. Assuming the cost of ice to be $5 per 2,000 lbs., this makes the cost $0.30 per week; and as the week was of about average temperature, it may be concluded that the cost per year is about $15 for ice.

The cost of the current consumed is also moderate. The insulation is so effective that approximately only one watthour a day is consumed per square foot of wall per degree Centigrade difference in temperature outside and inside. To make allowance for the occasional opening of the doors when the incubator is in moderate use, 10 per ct. is a fair amount to add to this, although the heat loss from this cause varies with the temperature of the incubator, temperature of the room, and frequency of opening the doors. These figures, however, are useful only for rough computation, as they were obtained by means of a commercial meter[5] which had not been standardized and was adapted for higher loads than furnished by the heaters. The radiation through cork-board of one inch thickness, as stated by the manufacturing company, is 6.0 British Thermal Units per square foot, per degree Fahrenheit difference in temperature. Based on this estimation, 0.786 watthours a day would be required for four-inch cork-board per square foot per degree Centigrade difference in temperature.

In actual use this has worked out as follows: With an average room temperature of 19° C, and the incubators in constant use at 37°, 30°, 25°, and 18°, respectively, 730 watthours have been consumed per day or about 255 kilowatthours per year. Allowing a cost of $0.10 per kilowatthour, the total cost per year is only $25.50.

[5] Thomson Watthour Meter (2 wire): Volts 100–110: Amp. 5; loaned by the courtesy of the Central New York Gas and Electric Co., Geneva, N. Y.

The total cost of maintenance is thus seen to be about $40 per year if based on the estimates of $5 per ton of ice and 10 cents per kilowatthour of electric power. These estimates are purposely high, and with the rates current here the cost is much less.

EFFICIENCY OF APPARATUS.

The efficiency of an incubator for bacteriological work is principally a matter of accuracy in temperature control. The temperature regularity of this incubator may be seen at a glance from Fig. 7

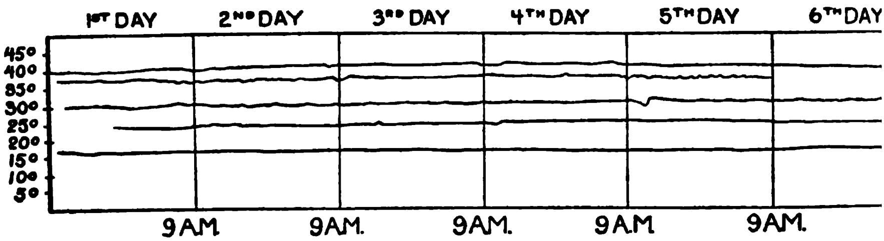

FIG. 7.—THERMOGRAPH RECORDS.
At 17.50°, 25°, 30°, 37° and 40° C.

which contains temperature curves obtained by means of a thermograph in the various chambers at 17.5°, 25°, 30°, 37° and 40°. All the variations are within one degree Centigrade except the one great irregularity in the 30° curve during the fifth day; and this irregularity was the result of shutting off the power for two hours. The most noticeable of all the other irregularities occur early in the morning; and it is thought they must be due in some way to the suddenly increased demand for electric power at the beginning of Station hours. The low temperature curves are particularly regular. This is especially interesting because of the difficulty often experienced in obtaining efficient incubators for temperatures below that of the room.

There is a difference in temperature, fully as great as this, between the top shelf and the floor of each incubator. This difference is 2° for chambers run at 30° or 37°, and 1° for chambers run at 18° or 25°. With chambers as high as these this difference is inevitable; but it can be allowed for by using the same shelf always for the same work.

In the refrigerator no attempt has been made to secure regularity in temperature. It varies with the outside temperature and the amount of ice within, and ranges between 7° and 10° C.

The whole piece of apparatus, indeed, seems to be very efficient, and, considering its size and accuracy, moderately inexpensive.

CONCLUSIONS.

A piece of apparatus built recently for this Station is a combination of four incubators, of 7 cu. ft. capacity each, and a refrigerator of 25 cu. ft. capacity. The incubators furnish temperatures between 18° and 50° C; while in the refrigerator a temperature of from 7° to 10° is obtainable.

The special features of this incubator are: electric heating, with all the power utilized in heat production inside the chambers; cooling by means of the drip-water from the refrigerator; and heat insulation by walls of four-inch cork-board.

This type of construction has the following advantages:

1. It is efficient. Heat control is accurate, and great constancy of temperature can be maintained.
2. It is not expensive. Cork-board is relatively cheap, and the cost of the heating apparatus is under $15. Total cost of construction under $400.
3. Cost of maintenance is low. The thorough insulation of the walls and the utilization of all the current within the chambers prevents loss of heat and therefore minimizes the consumption of power. Total cost is below $40 per year.
4. The risk of fire is negligible. Cork-board is not combustible, the renewal of oxygen through the cracks of the doors is too slow for active combustion, and the solder joints of the heating wires would melt and break the circuit before reaching a dangerously high temperature.

REPORT

OF THE

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TABLE OF CONTENTS.

REPORT OF THE DEPARTMENT OF BOTANY.

AN EXPERIMENT ON THE CONTROL OF CURRANT CANE NECROSIS BY SUMMER PRUNING.*

F. C. STEWART.

SUMMARY.

Necrosis, also known as wilt, blight and cane blight, is a destructive disease of currants in the Hudson Valley. In its most conspicuous form it is characterized by the sudden wilting and dying of canes here and there through the plantation. It is caused by the fungus *Botryosphæria ribis* which attacks the canes, killing and discoloring short sections of the bark and wood and thereby causing the death of all parts above the point of attack.

The behavior of the disease led to the belief that it could be controlled by the systematic removal of all diseased canes at intervals of three or four weeks during the spring and summer of each year. This bulletin contains, chiefly, an account of an experiment in which this method of treatment (called summer pruning) was tested. The experiment comprised six four-row plats each containing about one-fourth acre. Commencing when the plants had been set one year, three plats were carefully summer pruned from two to six times each year during six consecutive years. The alternate three plats were used as checks. The result was disappointing. At no time during the experiment was there any indication that the disease had been materially checked by the treatment. The infections seemed as numerous and as injurious on the treated as on the untreated plats and the yield of fruit was even smaller on the treated plats. Accordingly, summer pruning can no longer be recommended for the control of necrosis. In fact, no method of treatment can be confidently recommended at present.

* Reprint of Bulletin No. 357, February, 1913; for Popular Edition, see p. 725.

THE DISEASE.

The disease under consideration is one which is better known as wilt, blight or cane blight. It is the disease first brought to notice by Fairchild[1] in 1891 and described, in 1899, by Stewart and Blodgett[2] in Bulletin No. 167 of this Station under the name cane blight. In Technical Bulletin No. 18 of this Station Grossenbacher and Duggar[3] have given an account of the life history, biology and parasitism of the causal fungus, *Botryosphæria ribis* Gross. & Dug. Presumably, the currant disease studied by Durand[4] was the same; if so, he was in error in ascribing it to *Nectria cinnabarina.*

Briefly, the symptoms of necrosis are as follows: On certain canes or portions of canes the leaves wilt, turn brown and die. This may occur at any time while the plants are in foliage. An examination of an affected cane will reveal, somewhere, a section of dead wood one to four inches long. Here is the seat of the trouble. The bark has been killed and the wood and pith invaded by the mycelium of the causal fungus. This hinders the ascent of sap and thereby causes all parts of the plant beyond the point of injury to wither and die. To the casual observer the symptoms of necrosis resemble those shown by canes attacked by cane borers; but the difference is seen at once when an affected cane is split open. The cane borer forms a conspicuous burrow in the pith and, frequently, the larva itself is present; while in canes suffering from necrosis neither burrow nor larva is to be seen. By close observation one may detect a fine, whitish, cobwebby mycelium in the discolored pith at the point of attack. Its presence can generally be determined with the unaided eye and nearly always with the aid of a good hand lens.

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[1] Fairchild, D. G. Notes on a new and destructive disease of currant canes. *Bot. Gaz.* 16: 262. 1891.

[2] Stewart, F. C., and Blodgett, F. H. A fruit-disease survey of the Hudson Valley in 1899. N. Y. (State) Sta. Bul. 167: 292–4. 1899.

[3] Grossenbacher, J. G., and Duggar, B. M. A contribution to the life history, parasitism and biology of *Botryosphæria ribis*. N. Y. (State) Sta. Tech. Bul. 18. 1911.

[4] Durand, E. J. A disease of currant canes. N. Y. (Cornell) Sta. Bul. 125. 1897.

In the Hudson Valley, particularly in the vicinity of Highland, Milton and Marlboro where currants are grown extensively, necrosis is an important disease. In this region, it occurs to a greater or less extent in almost every currant plantation and is regarded as one of the chief hindrances to currant culture. Since the disease does not attack the roots new shoots continue to appear so that the plants are rarely killed outright; but as the plants grow older more and more of the canes succumb until, finally, there are so few fruit-bearing canes left that the plantation ceases to be profitable. While the virulence of the disease varies somewhat from year to year it is never wholly absent from a plantation in which it has once become established.

Necrosis occurs frequently, also, in central and western New York, but is rarely destructive, even in large plantations. The reason for this is not clear.

SUMMER PRUNING A THEORETICAL METHOD OF CONTROL.

Because of the damage done by necrosis there has been a steady demand for information concerning means of controlling it. The writer has advised making two or three systematic inspections of the plants during the spring and summer and promptly cutting out and burning all diseased canes found.[1] We call this the summer-pruning method. It depends for its success on the assumption that the diseased canes can be readily detected before the causal fungus has produced spores, thus making it possible to remove the affected canes before the disease has had a chance to spread.

Prior to the investigations of Grossenbacher and Duggar, the spore forms of the fungus were unknown, but it had been observed by Fairchild and the writer that canes killed by the fungus usually bear no spores of any kind until they have been dead a long time. Moreover, all attempts to make the fungus produce spores in artificial cultures have failed. Hence, the fungus came

[1] Stewart, F. C. Currant cane blight kept in control. *Amer. Agr.* 69: 820. 28 Je, 1902.

to be known as a "sterile" fungus. Grossenbacher and Duggar[1] found, however, that instead of being sterile the fungus possesses three conspicuous spore forms belonging to the genera Macrophoma, Dothiorella and Botryosphæria respectively. They found, also, that in spite of this wealth of spore forms infection apparently does not occur until after the middle of June. Therefore, it would seem as if the removal of affected canes in the spring should be decidedly helpful in keeping the disease under control. Winter pruning, on the contrary, is obviously ineffectual owing to the difficulty of detecting diseased canes while the bushes are bare of foliage.

TREATMENT EXPERIMENTS BEGUN.

Finally, in the spring of 1907 some treatment experiments were started at Milton, N. Y. It was realized, at the outset, that to rejuvenate an old, badly diseased plantation would be more difficult than simply to keep the disease from becoming established in a young plantation. So two experiments were commenced, one in a badly diseased twelve-year-old plantation and the other in a moderately affected one-year-old plantation. The former experiment was so planned as to show the effect of spraying and summer pruning separately and in combination. Bordeaux mixture was the fungicide used. It is unnecessary to give the details of the experiment. Before the close of the second season we became convinced that, under the prevailing conditions, the disease could not be controlled. In most of the plants the fungus had become firmly intrenched in the crown where it could not be entirely removed by pruning. Accordingly, the experiment in the old plantation was abandoned.

THE PRINCIPAL EXPERIMENT.

The experiment in the young plantation appeared more promising. The object of this experiment was to determine if necrosis

[1] Grossenbacher and Duggar. *Loc. cit.*

can be controlled by summer pruning commenced while the plants are young and continued regularly each season. The experiment was conducted on the farm of J. R. Clarke & Son, Milton, N. Y. It comprised 24 rows of currants, 512 feet long, planted in a pear orchard. The pear trees were planted 16 x 16 feet. The currants (variety, Cherry) were set in the rows of pear trees and also between them in such manner that two rows of pear trees included four rows of currants. At the beginning of the experiment there were blank spaces between every other pair of pear trees so that the currants stood in plats of four rows each with blank spaces 16 feet wide between plats. (See the accompanying diagram).[1]

```
    0xxxxx0xxxxx0
    xxxxxxxxxxxxx
I.
    xxxxxxxxxxxxx
    0xxxxx0xxxxx0
    .............
    .............
    0xxxxx0xxxxx0
    xxxxxxxxxxxxx
II.
    xxxxxxxxxxxxx
    0xxxxx0xxxxx0
```

The experiment included six of these four-row plats containing approximately one-fourth acre each. Three plats (II, IV and VI) were given the summer-pruning treatment while the alternating three plats (I, III and V) were left untreated for checks. In 1908 two rows of currants were planted in each of the blank spaces, but these were not included in the experiment.

The currants had been set out in the spring of 1906. Our experiment was begun in the spring of 1907 and continued through six seasons. Each winter all six plats were winter pruned in the usual manner under the direction of the owners. The spraying, also, was done by the owners. Each spring before the appearance of the leaves all six plats were sprayed with lime-sulphur for San José scale. Currant worms were well controlled on all plats by a single spraying made each season about June 1. For this purpose bordeaux and arsenate of lead were used in the first two seasons and lime-sulphur and arsenate of lead in the last four seasons. The summer pruning was all done by the writer

[1] O = pear tree; X = currant bush. Currants set 2½ to 3 feet apart in the row; rows 5⅓ feet apart. Dotted lines indicate the two rows of currants set between plats in 1908.

and his associates, J. G. Grossenbacher and W. O. Gloyer. To Mr. Grossenbacher, in particular, the writer is under obligation for much valuable assistance. The number of summer prunings varied from two to six in different seasons. At each pruning every plant on plats II, IV and VI was carefully examined and all dead or dying canes cut out, carried away and burned. In the removal of diseased canes an attempt was made to cut low enough to remove all of the fungus. It will be shown later that this was sometimes found difficult to accomplish.

A brief account of each year's work on the experiment will now be given.

FIRST SEASON.

During the first season of the experiment (1907) the three treated plats (II, IV and VI) were summer pruned six times on the following dates: May 20, June 10 and 26, July 17, August 16 and September 20. The small size of the plants at this time made it practicable for a man to cover two rows at each passage through the field. The prunings were placed in small piles between the rows and afterward carried out to the ends of the rows and burned. In the first pruning there were found large numbers of canes of the previous season's growth with 4 to 10 inches of their upper portion dead and without leaves. Some of these may have died from other causes than necrosis, but all were carefully cut out. Frequently, the pith was discolored for a distance of several inches below the lowest point of wood discoloration. In some cases this necessitated the removal of living branches.

SECOND SEASON.

In 1908 four prunings were made as follows: June 2 and 26, July 31 and August 21. The first pruning of this season should have been made earlier as the new shoots were so long (12 to 14 inches) that they hid the dead branches. Fifty dead canes were removed in the first pruning and 46 in the second. In the third pruning Mr. Grossenbacher noted 198 new cane infections and 49 old ones besides numerous leaf infections. In the fourth prun-

ing he found a total of 193 infections, 151 of which were leaf infections which had not yet entered the stem.

THIRD SEASON.

In 1909, also, there were four prunings made on the following dates: May 19, June 16, July 14 and August 18. The first pruning, on May 19, might better have been made on May 1. Considering the care with which the pruning had been done w were surprised to find that a good many canes were killed clear to the ground and the fungus had gained access to the crown of the plant. Four plants with single stems were entirely dead. Fifty-two diseased canes were removed in the second pruning and 69 in the third. The first pruning required two hours and forty-five minutes; the second, one hour and five minutes, and the third, one hour and fifteen minutes.

FOURTH SEASON.

This year pruning was done on May 2, June 6 and July 6. The spring was an unusually early one. At Milton, currants were in half bloom by April 18. Beginning with the first pruning of this year a single row was pruned at each passage through the field. Owing to the increased size of the plants it was found difficult to manage two rows at a time without overlooking some of the diseased canes. The time required for the first pruning (including removal of the prunings) was two hours and twenty minutes. Plats IV and VI each yielded one large armload of prunings while on Plat II there were more than could be carried at a single load. It was thought that time might be saved by putting the prunings into a large muslin bag slung over the shoulder, but a brief trial showed this method to be quite impracticable. Some of the affected canes were so large that they could not be put into the bag readily. This year, for the first time, the yield of fruit was measured. The three pruned plats yielded 2,402 quarts (3,193 qts. per acre) while the total yield of the three check plats was 2,481 quarts (3,296 qts. per acre).

FIFTH SEASON.

Three prunings were made: on May 22, June 12 and July 5. No record was made of the quantity of prunings or the time required to do the work in the first pruning. The second pruning required three hours and 8½ large arm-loads of prunings were obtained. The third pruning required 1½ hours. The quantity of prunings was small. On many plants the fungus had become firmly intrenched in the crown beyond the reach of the pruning knife. Also, it frequently happened that the point of attack was so close to a cluster of branches that, in order to get below the disease, it was necessary to remove the whole cluster of branches. In such cases there was some loss of fruit. Picking was begun on July 5. The total yield of the treated plats was 1,612½ quarts (2,143½ quarts per acre) and of the check plats 1,628½ quarts (2,165 quarts per acre).

SIXTH SEASON.

Only two prunings were made in 1912 (May 15 and June 11). The time required for the first pruning was five hours and ten minutes. The quantity of prunings amounted to about five large arm-loads and consisted entirely of dead canes. This pruning should have been made a few days earlier. In the second pruning there were found 174 plants more or less diseased and the fact that many of the affected canes were leafless showed that they had been overlooked in the first pruning. The time required for the second pruning was one hour and thirty-five minutes. It was planned to make a third pruning on July 18, but owing to the condition of the foliage it had to be abandoned. Hot weather and a light attack of anthracnose had brought about much tipburn and partial defoliation which made it very difficult to detect diseased canes. Much of the fruit being sun-burned and shriveled it was considered not worth while to measure the yield. Throughout the entire period of the experiment canes attacked by cane-borers were found only rarely.

As some changes contemplated by the owners necessitate the destruction of a portion of the experiment plantation, the experiment was brought to a close in the autumn of 1912.

COMMENTS ON RESULTS.

Our observation of this experiment forces us to the conclusion that currant cane necrosis can not be controlled by summer pruning. Theoretically, it should be effective, but when put to experimental test it has failed. At no time was there any indication that the treatment had materially checked the disease. Each spring treated and untreated plats showed an equal number of diseased canes so far as could be determined. Also, the yield of fruit on treated plats was even less than that on the checks.

Although the disease was not as destructive in the experiment plantation as in some others, it is believed that it was sufficiently abundant to make the test a fair one. Why the treatment failed is not entirely clear. Much difficulty was experienced in completely removing affected canes. In numerous instances it was observed that the disease had continued to work downward from cuts made in a previous pruning. Often it was found difficult to make the cut low enough to remove all of the fungus without sacrificing considerable living wood. Moreover, in spite of the most careful pruning the fungus often succeeded in reaching the crown of the plant where it could pass from one cane into another with impunity. Although no method of disinfecting the pruning knife was used it seems improbable that the fungus was spread by means of the pruning knife. It was deemed sufficient to occasionally wipe the knife-blade on the coat sleeve or trousers to remove adhering particles of diseased wood.

Another thing which may have been a factor in the failure of the treatment was the difficulty in finding all of the diseased canes. In the first pruning of the season diseased branches are to be detected chiefly by their being leafless. Accordingly, this pruning should be made just as soon as the leaves have started sufficiently to show readily which branches are dead. Probably

this is about the time the first berries are setting. The exact date will vary in different localities and in different seasons. If the first pruning is delayed until the new shoots have become several inches long it is inevitable that some of the diseased canes will be overlooked. This difficulty was encountered in the experiment. Besides, some late infections of the previous season are hard to detect under the most favorable conditions.

Perhaps a third factor in the failure of the treatment was the close proximity of the treated plats to untreated plats in which the disease was prevalent. Our present knowledge of the mode of dissemination of the fungus is so imperfect that we are unable to accurately estimate the importance of this factor.

The results of the experiment being as they are, we can no longer recommend summer pruning for the control of necrosis. It should be said, however, that it will probably assist greatly in keeping cane-borers under control and will improve the appearance of the plantation. The expense of four treatments will vary from $2 to $4 per acre according to the age of the plants and the virulence of the disease. With the rows six feet apart the affected canes may be removed at any time without material injury to either fruit or foliage. It is understood, of course, that most of the dead wood should be removed during the winter when other work is least pressing.

It is regrettable that summer pruning has proven a failure, because, at present, no other line of treatment can be confidently recommended. The planting of vigorous-growing varieties such as Wilder may give some relief. An experiment on the control of necrosis by spraying is in progress.

SEED TESTS MADE AT THE STATION DURING 1912.*

M. T. MUNN.

SUMMARY.

In Part I of this Bulletin will be found, (1) a reprint of the law governing the inspection and sale of seeds, (2) a brief statement of the method employed in finding the percentages of impurity of the samples analyzed, (3) a table showing the percentage composition of about 125 samples collected, under the law, after July 1, 1912, (4) results of some studies on the relationship between "weight" and "count" standards of purity, and (5) comments on the results of the inspection and the bearing of the law on agricultural interests.

Of the samples examined officially, about 20 per ct. contained greater percentages of impurities than the law allows without specific labeling.

Part II contains a brief report upon the seed trade conditions in this State, as revealed by the examination of 1140 samples of seed received from correspondents during the calendar year 1912, consisting of 621 samples of alfalfa, 170 of red clover, 150 of timothy, 96 of alsike clover, and 47 miscellaneous samples.

Thirteen samples of alfalfa seed had been adulterated, sand, crushed rock, broken seed, inert matter and yellow trefoil seed being the adulterants used. Eighty-six per ct. of the samples of hairy vetch had been adulterated with the seed of other vetches, notably spring vetch.

Thirteen per ct. of the alfalfa samples, and nineteen per ct. of the red clover samples contained dodder seed, and the experience of farmers with this pest during the past season calls for a note of warning to prospective buyers.

Many of the samples were too small for a dependable analysis. Small packets of seed distributed by some seed dealers as representative advertising samples were found not to be fully representative. The long list of foul and foreign seeds appears to be steadily increasing, mainly by the additional occurrence of new weeds. The most common impurities were plantain

* Reprint of Bulletin No. 362, February, 1913; for Popular Edition, see p. 741.

mustard, green foxtail, chicory, and curled dock, with Russian thistle and roquette as new arrivals which attract much attention, but have so far proved to be of little importance in New York alfalfa fields. Examination of samples of alsike and timothy mixtures and of lawn grass mixtures revealed a very serious condition as regards purity. Such mixtures should be avoided.

I. INSPECTION OF AGRICULTURAL SEEDS.

Part I of this Bulletin gives the results of the analyses of samples of agricultural seeds collected by the Commissioner of Agriculture during the six months following July 1, 1912. These samples were collected under the provisions of Article 15 of the Agricultural Law, which took effect on the above date, and were transmitted for analysis to the Director of the New York Agricultural Experiment Station, in accordance with the provisions of Section 341 of said law. These analyses and other additional information are published by the Director in accordance with said Section 341.

Preceding the tables are given: The provisions of the law relative to the sale and inspection of agricultural seed, and a discussion of the methods of analysis as required by the law; while following the table are comments on the results of studies made in an attempt to secure standards giving the number of seeds per unit weight for the common crop seeds; and, lastly, a brief discussion of what the inspection reveals as to the character and quality of the agricultural seeds offered for sale in this State, and the significance of the inspection to New York farmers.

PROVISIONS OF THE AGRICULTURAL LAW RELATIVE TO THE INSPECTION AND SALE OF AGRICULTURAL SEED.

ARTICLE 15 OF THE AGRICULTURAL LAW.

Inspection and Sale of Seeds.

§ 340. Inspection and sale of seeds. Within the meaning of this article "agricultural seeds" are defined as the seeds of

alfalfa, Canadian blue grass, Kentucky blue grass, alsike clover, crimson clover, red clover, white clover, vetch orchard grass, rape, red top, and timothy which are to be used for sowing or seeding purposes. No person, firm or corporation shall sell, offer, expose or have in his possession for sale for the purposes of seeding, any seeds of grasses or clovers, of the kind known as agricultural seeds containing in excess of three per centum by count of foul or foreign seeds, unless every receptacle, package, sack or bag containing such seeds is plainly marked or labeled with the per centum of such foul or foreign seeds contained therein.

§ 341. Samples, publication of results of examination. The commissioner of agriculture or his duly authorized representatives shall take samples of seed in triplicate in the presence of at least one witness and in the presence of such witness shall seal such samples and shall at the time of taking tender, and if accepted, deliver to the person apparently in charge one of such samples; one of the other samples the commissioner of agriculture shall cause to be analyzed. The director of the New York agricultural experiment station shall analyze or cause to be analyzed such samples of seeds taken under the provisions of this article as shall be submitted to him for that purpose by the commissioner of agriculture and shall report such analysis to the commissioner of agriculture, and for this purpose the New York agricultural experiment station may employ experts and incur such expenses as may be necessary to comply with the requirements of this article. The result of the analysis of the sample or samples so procured, together with such additional information as circumstances advise, shall be published in reports or bulletins from time to time.

Penalties.

Section 52 of the Agricultural Law relates to penalties and is as follows:

§ 52. Penalties.— Every person violating any of the provisions of this chapter, shall forfeit to the people of the state of New York the sum of not less than fifty dollars nor more than one

hundred dollars for the first violation and not less than one hundred dollars nor more than two hundred dollars for the second and each subsequent violation. When such violation consists of the manufacture or production of any prohibited article, each day during which or any part of which such manufacture or production is carried on or continued, shall be deemed a separate violation. When the violation consists of the sale, or the offering or exposing for sale or exchange of any prohibited article or substance, the sale of each one of several packages shall constitute a separate violation, and each day on which any such article or substance is offered or exposed for sale or exchange shall constitute a separate violation. When the use of any such article or substance is prohibited, each day during which or any part of which said article or substance is so used or furnished for use, shall constitute a separate violation, and the furnishing of the same for use to each person to whom the same may be furnished shall constitute a separate violation. Whoever by himself or another violates any of the provisions of articles three, four, six, eight and nine or sections three hundred fourteen and three hundred fifteen of this chapter or of sections one hundred six, one hundred seven and one hundred eight of this chapter shall be guilty of a misdemeanor, and upon conviction shall be punished by a fine of not less than fifty dollars, nor more than two hundred dollars, or by imprisonment of not less than one month nor more than six months or by both such fine and imprisonment, for the first offense; and by six months' imprisonment for the second offense.

METHOD OF ANALYSIS.

The method of analysis as required by the law is entirely different from any in use at the present time. It is required that the percentage of purity shall be determined by a "count" of the number of foul or foreign seeds in a given quantity of crop seed. In making the analyses reported in the following table, the rules for seed testing as outlined in Office of Experiment Stations Cir. No. 34 (Revised), 1904, were followed as closely as possible. The

regulation weight of sample was used and the seed impurities counted as were also crop seeds in the sample. From these data the percentage of each was determined by the proportional number of seeds in the sample. The percentage of inert matter was determined by weight.

REPORT OF ANALYSES OF SAMPLES OF SEEDS COLLECTED BY THE COMMISSIONER OF AGRICULTURE DURING 1912.

Sample No.	Kind of seed, brand or trade name, name of dealer, and place of collection.	Composition.		
		Foreign seed.	Inert matter.	Pure seed.
		Per ct.	Per ct.	Per ct.
	Alfalfa:			
256	Alfalfa Chas. F. Saul, Syracuse.	.32	1.	98.68
253	Alfalfa Craver-Dickinson Seed Co., Binghamton.	.40	.50	99.10
173	Alfalfa C. A. Session & Son, Palmyra.	.48	.40	99.12
169	Alfalfa Seed Dorchester & Rose, Geneva.	.27	.60	99.13
207	Alfalfa Louis Bush, Lowville.	.12	.20	99.68
212	Anchor Brand Gilbert & Nichols Co., Fulton.	.31	1.	98.69
166	Cane R. A. Mather, Canandaigua.	.18	.40	99.42
378	Choice W. R. Perkins & Co., Newburgh.	.12	.90	98.98
353	Eclipse John A. Reynolds, Albany.	None.	.80	99.20
259	Eclipse Elmore Milling Co., Oneonta.	.03	.80	99.17
367	I. X. L. Jansen & Shuestis, Fonda.	.22	.10	99.68
	Alsike Clover:			
206	Alsike Clover Milton T. Jones, Utica.	2.70	.80	96.50
210	Alsike Louis Bush, Lowville.	6.15	2.	91.85
104	Alsike Clover Albert G. Johnson, Jamestown.	3.47	1.	95.53
170	Alsike Dorchester & Rose, Geneva.	1.86	.20	97.94
271	Alsike Clover Frederick L. Jennings, Elmira.	4.37	.30	95.33
358	Alsike Becker & Co., Central Bridge.	.39	.50	99.11
366	Alsike Jansen & Shuestis, Fonda.	.09	.10	99.81

REPORT OF ANALYSES OF SAMPLES OF SEEDS (*continued*).

Sample No.	Kind of seed, brand or trade name, name of dealer, and place of collection.	Composition.		
		Foreign seed.	Inert matter.	Pure seed.
		Per ct.	*Per ct.*	*Per ct.*
	ALSIKE CLOVER (*concluded*):			
261	Eclipse Elmore Milling Co., Oneonta.	12.64	5.	82.36
385	Fancy John L. Dillon, Salem.	2.09	1.	96.91
383	Fancy Webster Pratt, Buskirk Bridge.	.49	.40	99.11
389	TX H. S. & J. S. Shippy, Hudson Falls.	45.01	8.	46.99
185	Alsyke James Vick's Sons, Rochester.	2.01	.20	97.79
278	Port Alsyke I. S. Matthews Sons, Binghamton.	.37	.10	99.53
	CANADIAN BLUE GRASS:			
372	Cana Blue Grass Chas. W. Witbeck, Schenectady.	3.91	12.	84.09
260	No. 1 Elmore Milling Co., Oneonta.	2.45	2.	95.55
258	Canadian Blue Grass Chas. F. Saul, Syracuse.	2.81	5.	92.19
177	Canadian Blue Grass Briggs Bros. & Co., Rochester.	1.03	2.10	96.87
371	Climax Chas. W. Whitbeck, Schenectady.	4.85	8.	87.15
	CRIMSON CLOVER:			
373	Crimson Clover Chas. W. Witbeck, Schenectady.	1.20	3.	95.80
	KENTUCKY BLUE GRASS:			
257	Kentucky Blue Grass Chas. F. Saul, Syracuse.	.22	3.	96.78
252	Kentucky Blue Grass Craver-Dickinson Seed Co., Binghamton.	.19	5.	94.81
178	Kentucky Blue Grass Briggs Bros. & Co., Rochester.	.11	.90	98.99
186	Kentucky Blue Grass James Vick's Sons, Rochester.	.14	2.80	97.06
182	Blue Grass Maurer-Haap Co., Rochester.	.38	.90	98.72
	RAPE:			
180	Essex Briggs Bros. & Co., Rochester.	None.	.90	99.10
	RED CLOVER:			
204	Ace Brand Hogle Milling Co., Malone.	1.47	.30	98.23

Report of Analyses of Samples of Seeds (*continued*).

Samp'e No.	Kind of seed, brand or trade name, name of dealer, and place of collection.	Composition.		
		Foreign seed.	Inert matter.	Pure seed.
		Per ct.	*Per ct.*	*Per ct.*
	Red Clover (*concluded*):			
276	Ace Mammoth. I. S. Matthews Sons, Binghamton.	.18	.40	99.42
387	Atlas Mammoth. Braymer & Cullin, Granville.	1.55	1.	97.45
352	Cadillac. John A. Reynolds, Albany.	.55	2.20	97.25
376	Choice Medium. C. G. Clark, Westtown.	1.21	.20	98.59
384	Crown Mammoth. Webster Pratt, Buskirk Bridge.	.26	.50	99.24
377	Crown Medium 104. Hallock & Nichols, Washingtonville.	2.41	.30	97.29
266	Eclipse. Elmore Milling Co., Oneonta.	.58	.20	99.22
368	Kaiser Brand. Jansen & Shuestis, Fonda.	4.80	2.40	92.80
277	Kaiser Medium. I. S. Matthews Sons, Binghamton.	3.15	.70	96.15
357	Guaranteed Large. Becker & Co., Central Bridge.	2.10	1.	96.90
175	Medium. C. A. Session & Son, Palmyra.	.17	.80	99.03
356	Paragon Mammoth 102. Becker & Co., Central Bridge.	.92	.50	98.58
265	Placer. Elmore Milling Co., Oneonta.	3.97	1.	95.03
272	Red Clover. F. L. Jennings, Elmira.	.66	.20	99.14
154	Royal Medium. Chaffee, Rowe & Kennedy, Castile.	1.44	.60	97.96
264	Wib. Elmore Milling Co., Oneonta.	4.45	1.	94.55
	Red Top:			
355	Ace Brand R. T. 92982. H. W. Gordinier & Sons Co., Troy.	.41	5.	94.59
262	Eclipse Fancy. Elmore Milling Co., Oneonta.	.86	4.	95.14
386	Fancy. John L. Dillon, Salem.	4.56	2.	93.44
375	Fancy. C. G. Clark, Westtown.	.60	4.	95.40
181	Globe Brand. Maurer-Haap Co., Rochester.	.06	.50	99.44
187	Red Top Grass. James Vick's Sons, Rochester.	1.10	2.30	96.60
102	Ace Brand. J. H. Fairchild & Son, Portville.	.40	2.50	97.10
183	Red Top. Maurer-Haap Co., Rochester.	.49	36.50	63.01

REPORT OF ANALYSES OF SAMPLES OF SEEDS (*continued*).

Sample No.	Kind of seed, brand or trade name, name of dealer, and place of collection.	Composition. Foreign seed.	Inert matter.	Pure seed.
		Per ct.	*Per ct.*	*Per ct.*
	TIMOTHY:			
363	Acme Jansen & Shuestis, Fonda.	.24	.20	99.56
211	Anchor Brand Gilbert & Nichols Co., Fulton.	.91	.20	98.89
171	Arrow Brand G. C. Dorsey, Geneva.	.34	.20	99.46
381	Arrow W. F. Weston, Fishkill Landing.	.09	.20	99.71
354	Bison Brand H. W. Gordinier & Sons Co., Troy.	.88	2.50	96.62
361	Bingo Brand Jansen & Shuestis, Fonda.	.02	.10	99.88
251	Blue String Globe Craver-Dickinson Seed Co., Binghamton.	Trace.	.30	99.+
161	Bon J. C. McVean, Scottsville.	.40	.30	99.30
152	Globe Bright Hulled Briscoe & Tupper, Churchville.	.14	Trace.	99.+
254	Choice Chas. F. Saul, Syracuse.	Trace.	.50	99.+
359	Colonial Plank & Righter, Altamont.	.42	.30	99.28
176	Eagle John De Frine, Williamson.	.30	1.10	98.60
209	Eagle Louis Bush, Lowville.	.89	.50	98.61
267	Eclipse Elmore Milling Co., Oneonta.	.43	.60	98.97
369	Eclipse Chas. W. Witbeck, Schenectady.	1.04	1.	97.96
157	Erie Brand E. B. Osborn, Mount Morris.	.12	.10	99.78
202	Globe Bright Hulled Norwood Feed & Supply Co., Norwood.	.05	.40	99.55
201	Globe Brand Norwood Feed & Supply Co., Norwood.	.04	.60	99.36
167	Globe Brand H. S. Schoonmaker, Seneca Castle.	.20	.10	99.70
362	Globe Brand Van Epps & Dunn, Fultonville.	.04	.08	99.88
159	Gold Brand Ryan Bros., Le Roy.	.22	.30	99.48
270	Gold Brand A. F. Landers, Whitneys Point.	.36	.20	99.44
374	Gold Brand J. W. Halliday, Unionville.	.14	.20	99.66
168	Home Grown Dorchester & Rose, Geneva.	1.70	.30	98.

Report of Analyses of Samples of Seeds (*continued*).

Sample No.	Kind of seed, brand or trade name, name of dealer, and place of collection.	Composition.		
		Foreign seed.	Inert matter.	Pure seed.
		Per ct.	*Per ct.*	*Per ct.*
	Timothy (*continued*):			
156	Honor Brand J. J. Martin, Perry.	.80	.20	99.
172	Jap S. G. Crump, Pittsford.	.04	.60	99.36
275	Justice Asi Guernsey, Lisle.	.11	.10	99.79
364	King K. G. Jansen & Shuestis, Fonda.	.38	.20	99.42
274	Liberty William J. Davis, Ithaca.	.32	.15	99.53
382	Liberty J. P. Skiff, Buskirk.	.68	.20	99.12
255	Onondaga Chas. F. Saul, Syracuse.	.14	.50	99.36
151	Pan-American F. T. & E. H. Miller, Byron.	.39	Trace.	99.+
365	Pan-American Jansen & Shuestis, Fonda.	.62	.25	99.13
101	Timothy Edwin A. Bagg, Conewango Valley.	.02	.40	99.58
153	Pine Tree Brand Chaffee, Rowe & Kennedy, Castile.	.32	.20	99.48
188	Pine Tree Brand Brewster, Crittenden & Co., Rochester.	.02	.10	99.88
203	Pine Tree Brand George G. Ramsey, Ogdensburg.	.08	.50	99.42
269	Pine Tree Brand Robert Nichol, Rocksbury.	.26	.40	99.34
273	Pine Tree Brand Chas. L. Babcock, Addison.	.19	.60	99.21
351	Pine Tree Brand John A. Reynolds, Albany.	.17	Trace.	99.5+
208	Royal Louis Bush, Lowville.	.53	.40	99.07
360	Safe D. B. Abrams & Co., Gloversville.	.07	.20	99.73
174	Square Deal C. A. Session & Son, Palmyra.	.34	.30	99.36
388	Square Deal Braymer & Cullin, Granville.	.19	.20	99.61
158	Superfine A. N. Stewart, Livonia.	.32	.30	99.38
205	Veri-best M Brand Smallman & Spencer, Malone.	1.53	.60	97.87
179	Waski Briggs Bros. & Co., Rochester.	38.90	3.80	57.30
268	Win Elmore Milling Co., Oneonta.	.81	.50	98.69
103	Timothy W. E. Shaeffer, Lockport.	.24	.30	99.46

REPORT OF ANALYSES OF SAMPLES OF SEEDS (*concluded*).

Sample No.	Kind of seed, brand or trade name, name of dealer, and place of collection.	Composition.		
		Foreign seed.	Inert matter.	Pure seed.
		Per ct.	Per ct.	Per ct.
	TIMOTHY (*concluded*):			
105	Timothy A. G. Johnson, Jamestown.	.05	.10	99.85
106	Timothy Henry & Missert, Buffalo.	.75	.20	99.05
155	Timothy LeRoy Power & Milling Co., LeRoy.	1.16	.30	98.54
160	Timothy Charles Olmsted, Livonia.	17.10	1.	81.90
163	Timothy Walter H. Clark, Avon.	6.93	1.50	91.57
164	Timothy Frank Minahan, Honeoye.	3.69	.70	95.61
165	Timothy Alexander Davidson, Canandaigua.	.24	.10	99.66
	VETCH:			
379	Summer W. R. Perkins & Co., Newburgh.	.13	1.	98.87
380	Winter W. R. Perkins & Co., Newburgh.	25.66	1.60	72.74
	WHITE CLOVER:			
263	Cascade Elmore Milling Co., Oneonta.	4.65	2.50	92.85
370	Cherry Chas. W. Witbeck, Schenectady.	16.32	10.	73.68
280	White Clover I. S. Matthews Sons, Binghamton.	.28	.60	99.12
279	White Clover I. S. Matthews Sons, Binghamton.	.56	1.20	98.24
184	White Clover James Vick's Sons, Rochester.	.49	.10	99.41

RELATIONSHIP BETWEEN "WEIGHT" AND "COUNT" METHODS FOR DETERMINATION OF PERCENTAGE OF PURITY OF SEED.

In order to eliminate the time-consuming task of finding the number of crop seeds in a given weight of the sample, it seemed necessary to establish some "standards" as to the number of seeds per unit weight for the various kinds of crop seed. In view of

the fact that the number of seeds in any given weight of seed may vary considerably, it was evident, that, if such standards for the agricultural seeds could be formulated, the question might be raised in any case as to the facts in regard to that particular sample if the percentage of purity was determined on the basis of an average number of seeds per unit weight for that kind of seed; for this reason actual counts were made in all official samples as noted on p. 157.

In pursuing the laborious task of finding the number of seeds per unit weight in each sample analyzed, many facts of interest and importance emerged. The number of seeds per unit weight in any one kind of seed was found to vary widely. In the case of two samples of high grade alfalfa seed the number of seeds per pound varied from 213,000 to 250,000. In two samples of pure spring vetch, the number of seeds varied from 475 to 800 per 30-gram sample. In other kinds of seed the variation was equally great. To a certain extent the number of seeds varied with the grade of the seed. This variance in the number of seeds in different samples can be attributed to a number of causes and conditions, chief among them being the size of the seed, which depends upon the locality in which it is grown and the more or less favorable character of the season during which the seed was harvested; therefore, the number of seeds per unit weight may vary from year to year, and standards for one season would not necessarily be even approximate for official results for the following seasons, and could not be applied, with any degree of accuracy, to all samples collected during any one season if they represented seed from the harvest of two different seasons, or different localities.

Kajanus* in his work on germination tests of the different colored seeds of red clover found that yellow and brown-colored seeds appeared about equal in weight, but that violet-colored seeds were much heavier.

The writer made a number of counts upon red clover samples to find the relative percentage of violet and yellow-colored seeds. The percentage of yellow-colored seed was found to be higher than

* *Landw. Jahrb.* 41: 527-533, 1911.

the percentage of violet-colored seed, and while the range of difference is fairly constant in samples from one season, in samples from different seasons the percentage of violet-colored seed would be increased or decreased; and with this change there would be a variation in the number of seeds per unit weight.

In grass seeds, especially redtop and blue grass, the number of seeds per unit weight varied greatly and followed closely the grade of the seed. In two samples of redtop seed the number of seeds varied from 8,500 to 14,500 per gram. Extra clean redtop seed gave a much higher number of seeds per unit weight than did the poorer grades. The number of seeds per gram in timothy seed depended upon the extent to which it was hulled. Seed that was nearly hull-less gave a count of 3,010 seeds per gram, while seed with hulls still adhering gave a count of 2,600 seeds per gram. It seems certain, then, that standards per unit weight would be necessary for each grade of seed, and it would be desirable to determine into which grade of seed the sample of grass seed under consideration belongs in order to arrive at a fairly accurate purity percentage.

A comparison of the two methods, by weight and by count, as employed in the determination of purity percentage, was of much interest since it showed the possible cases in which the two methods gave widely different results. The seed impurities from samples were both weighed and counted and results showed that in every case where the seed was well cleaned and the seed impurities were about the same size as the crop seed, even if they represented several species, the two methods agreed quite closely.

It was found that the lower the grade of the seed and the less the amount of cleaning it had received, the smaller in size were the seed impurities and consequently the higher was the percentage of impurity by count as compared with the percentage of impurity by weight. The smaller and lighter the foreign seeds are with respect to the size and weight of the crop seed in which they are found the greater is the variation in the two methods, the percentage of impurity by count increasing more rapidly than the percentage by weight as the relative size of the impurities de-

creases. When the foreign seeds are of all sizes, both larger and smaller than the crop seeds, or when they are approximately the same size and weight as the crop seeds, the two methods agree closely.

A comparison was made of the time required to secure a complete report upon a sample when both methods were employed; and the conclusion was reached that, even if standards could be derived, which seems hardly possible in some cases, the determination of purity by count would be more time-consuming than by weight. If the number of seeds per unit weight for each sample was determined as a basis upon which to derive the purity percentage of that sample the time required to analyze seed by the count method would be almost prohibitive to that method.

The following table gives the average number of seeds per unit weight for the common crop seeds designated in the law as agricultural seeds. These results are the averages obtained by counts made upon samples of seed obtained upon the open market by the seed inspectors.

Table II.—Average Number of Seeds per Unit Weight for "Agricultural Seeds."

Kind of Crop Seed.	Number of samples counted.	Number of seed per gram.	Number of seed in regulation sample.	Number of Seed per Pound.		
				Maximum.	Minimum.	Average.
		Av.	*Av.*			
Alfalfa	30	501	2,505	244,944	223,192	227,254
Alsike clover	19	1,595	3,190	732,564	657,720	723,492
Canada blue grass	10	6,138	6,138	3,197,880	2,476,656	2,794,197
Crimson clover	8	322	1,610	180,625	127,482	146,059
Kentucky blue grass	7	4,910	4,910	2,687,580	2,086,560	2,227,176
Orchard grass	4	1,318	2,636	943,488	564,732	597,845
Rape, Dwarf Essex	3	242	2,423	113,400	105,688	109,771
Red clover	25	673	3,366	347,004	273,067	305,272
Redtop	19	10,020	10,020	6,599,880	3,755,808	4,545,072
Timothy	35	2,775	5,550	1,474,200	1,095,444	1,258,740
Vetch, spring[1]	2	21	637	12,067	7,166	9,526
Vetch, winter[2]	5	34	1,019	15,921	14,787	15,422
White clover	8	1,572	3,144	789,264	662,256	713,059

[1] Spring, or common, vetch, *Vicia sativa*.
[2] Winter, hairy, or sand, vetch, *Vicia villosa*.

DISCUSSION OF THE RESULTS OF THE INSPECTION AND ITS SIGNIFICANCE TO NEW YORK FARMERS.

The number of official samples collected during the first six months in which the law was in force is not large enough to permit of very definite conclusions; however, it is important to know that slightly over 20 per ct. of the samples analyzed did not meet the requirements of the law, that is, they contained over 3 per ct. of foreign seeds by count and were not so labeled. White clover, winter vetch, alsike clover, orchard grass, Canadian blue grass and red clover in the order named were the most frequent violators.

While it is not within the province of the Station to decide upon any moral or legal phase of the seed law, it seems advisable to point out that the present seed law simply requires that agricultural seeds shall not contain over 3 per ct. foul or foreign seed by count, unless the per centum of such foul or foreign seed is plainly marked or labeled on the container. Every farmer should know that an allowance of 3 per ct. impurity by count affords ample opportunity for the introduction of a large number of noxious weeds upon the farm. If alfalfa or clover seed were sown at the rate of ten pounds of seed per acre, the 3 per ct. impurity by count would permit the introduction of approximately 62,566 weed seeds per acre, or about one and one-half seeds per square foot. In the case of dodder such an introduction would be a serious one. It is therefore evident that the purchaser must rely upon his own ability to judge of the quality of the seed, since the law does not designate or require a reasonable freedom from dodder seed, or a certain freedom from inert matter, and consequently affords only a partial protection.

II. ANALYSES OF SEED SAMPLES RECEIVED FROM CORRESPONDENTS.

INTRODUCTION.

It is the primary purpose to present, in Part II of this Bullotin, the results of seed tests made upon samples of seed that have

been sent to the Station by correspondents during the past year, and also to discuss the seed-trade conditions in this State as revealed by the samples submitted for analysis. The results of these tests do not have the range and accuracy of those secured by the official inspection; however, the results no doubt reflect very accurately the condition of the seed sold upon the open market, since the samples were received from all parts of the State and from many of the larger seed companies. Such seed examination is done free of charge to residents of the State if samples are received not too frequently from one individual. During the past year 1,140 samples of seed were examined and reported upon.

Samples received prior to June 24 were examined by Miss Minerva Collins (now Mrs. Richard Wellington), Assistant Botanist, who resigned June 30, 1912.

PURITY TEST.

The value of a purity test depends almost entirely upon the manner in which the sample submitted for analysis is taken, and whether it represents to the fullest extent the bulk of seed from which it was drawn. A seed sample to be of value for examination should be a composite sample taken from the entire bulk of seed, whether in a bin or in bags, and should weigh *at least 2 ounces.*

The number of samples received during the past few years has reached such proportions that it has become impossible, during the time available for such work, to give a detailed quantitative report upon any one sample. However, in all cases a practical report relating to the presence of noxious weeds, adulterants, and general appearance of the sample is given. Such general reports are often supplemented by a note at the bottom of the report sheet in cases where it seems warranted.

Many of the samples sent for examination were entirely too small for a dependable analysis. Some small samples, which showed the seed to be apparently pure, might have revealed the presence of noxious weed seeds if a larger sample had been sent

for examination. Attention should be called to the undesirability of accepting as a final guide to quality the small packets of seed put out by some seed dealers as representative advertising samples of the seed sold by them during the season, since it has been found that in many cases such samples do not represent fully the seed sold.

GERMINATION TESTS.

Germinability is of as much interest as is purity and in some cases of more importance, but tests for germination may and should be made by each individual farmer or seed-grower. Such tests are easily made by the use of simple, home methods which are very reliable and are fully described in Leaflet M, of this Station, which will be sent upon request.

Germination tests reveal the presence of old seed which may have been mixed with new seed as a means of disposing of the former, and also give the percentage of strong seeds, which can be used as a guide at seeding time. Many requests are received for germination tests, but owing to the fact that the Station is not equipped to make large numbers of tests it seems necessary to refuse such requests. Really, the Station should not be asked to make such tests, as they are so easily carried out at home.

ADULTERATION.

Adulteration of crop seeds, while becoming less common in the State, was occasionally encountered in alfalfa samples, and in samples of hairy vetch seed. Seven samples of alfalfa were found to contain a considerable amount of some yellow, foreign seed broken into pieces about the size of alfalfa seed. This material was of a lighter color than alfalfa seed, irregular in shape and of such size that it passed through a sieve of 20 meshes to the linear inch, used to remove dodder from alfalfa seed. It seems very evident that this material was added intentionally.

One sample of alfalfa seed was found to contain 13 per ct. of dead seed which had been used as an adulterant. Several other

samples contained varying amounts of dead seed but not to so great an extent.

Sand or crushed rock was found as an adulterant in four samples of alfalfa seed. One of these samples contained 2.5 per ct. of crushed rock, and another sample contained 1.8 per ct. of sand. Both of these adulterants were readily removed by the use of a sieve such as would be used in cleaning alfalfa.

One sample of alfalfa contained 13 per ct. of inert matter, consisting of broken seed, sticks and dirt, which had undoubtedly been used as an adulterant.

Eighty-three per ct. of the samples of hairy, winter, or sand, vetch seed examined, were found to be adulterated with seed of spring vetch and other vetches. One sample was found to contain over 25 per ct. of spring or common vetch.

It is quite probable that many of the failures with hairy vetch that have been reported by orchardists and grape growers in this State have been due to the adulteration of this seed with old, dead seed, low-grade screenings and seed of other vetches, or to the presence of hard seed which is incapable of germinating, as has been revealed by germination tests.

Some of the supposed cases of winter-killing with winter vetch have been found to be due to the adulteration of the seed with that of spring vetch, which will not withstand the winter.

Several samples of alsike clover were found to contain yellow trefoil seed to such an extent that adulteration was suspected. One sample of alsike clover contained 17 per ct. of yellow trefoil seed, but upon investigation it was found that it was a case of natural mixture, owing to the field in which the seed had been grown being badly infested with yellow trefoil.

IMPURITIES.

From the examination of seed samples and a study of the occurrence and introduction of weeds into the State it seems that in many cases the solution of the weed problem depends upon the use of pure seed. The number and variety of seed impurities

found in crop seeds is no doubt largely due to the production of seed as a secondary feature of the culture of the crop.

The following table gives a complete list of the foreign seeds or seed impurities found in samples analyzed, with the number and kind of samples in which they were found:

TABLE III.— FOREIGN SEEDS FOUND IN SEED SAMPLES AND THE NUMBER AND KIND OF SAMPLES IN WHICH THEY OCCURRED.

NAMES OF FOREIGN SEED.	KIND OF CROP SEED.									
	Alfalfa.	Red clover.	Timothy.	Alsike clover.	Alsike and timothy mixture.	Redtop.	Hairy vetch.	White clover.	Kentucky blue grass.	Miscellaneous samples.
Number of samples examined	621	170	150	96	17	14	14	13	14	31
Alfalfa (*Medicago sativa* L.)	...	11	8	16	...	...	...	...	...	1
Alfilaria (*Erodium cicutarium* (L.) L'Her.)	2	1	...	...	...	...	...	...	...	...
Alsike clover (*Trifolium hybridum* L.)	60	99	111	...	...	...	...	11	2	7
Ax seed (*Coronilla scoparioides* Koch.)	3	17	...	...	...	...	...	...	...	...
Barnyard grass (*Echinochloa crus-galli* (L.) Beauv.)	43	13	...	...	...	...	...	...	...	1
Bindweed, black (*Polygonum convolvulus* L.)	2	...	...	...	...	...	...	...	...	...
Bird's-foot trefoil (*Lotus corniculatus* L.)	21	23	...	...	...	...	1	...	...	1
Black-eyed Susan (*Rudbeckia hirta* L.)	1	2	16	1	12	5	...	...	...	...
Black medick (*Medicago lupulina* L.)	13	28	3	37	1	...	...	6	1	2
Bladder ketmia (*Hibiscus trionum* L.)	2	...	...	...	...	...	...	...	...	...
Blue field madder (*Sherardia arvensis* L.)	12	30	1	...	...	...	...	3	...	1
Blue grass (*Poa pratensis* L.)	...	...	13	3	1	...	...	1	2	4
Bull thistle (*Cirsium lanceolatum* (L.) Hill)	1	3	...	...	...	...	...	...	...	1
Burdock (*Arctium minus* Bernh.)	2	...	...	...	...	...	...	...	...	...
Bur clover (*Medicago hispida* Gaertn.)	3	...	...	...	...	...	...	...	...	...
Buttercup (*Ranunculus bulbosus* L.)	...	...	...	...	...	...	...	...	...	1
Canada thistle (*Cirsium arvense* (L.) Scop.)	2	14	7	18	3	...	...	...	1	...
Caraway (*Carum carui* L.)	1	...	...	...	...	...	...	...	...	...
Catnip (*Nepeta cataria* L.)	1	9	8	2	...	...	...	...	...	...
Chess; cheat (*Bromus secalinus* L.)	1	5	...	...	...	...	...	...	...	...
Chicory (*Cichorium intybus* L.)	65	27	1	...	1	...	...	...	...	...
Cinquefoil (*Potentilla canadensis* L.)	...	...	2	...	...	...	...	...	...	...
Cinquefoil (*Potentilla monspeliensis* L.)	...	...	51	4	14	5	...	...	1	4
Cleavers (*Galium aparine* L.)	...	...	...	...	...	...	4	...	...	...
Cleavers (*Galium mollugo* L.)	...	1	...	...	...	...	...	...	...	...
Cockle (*Agrostemma githago* L.)	...	...	...	...	...	...	10	...	...	...
Compositae, spp.	2	1	...	...	...	...	...	...	...	1
Corn chamomile (*Anthemis arvensis* L.)	3	5	3	6	...	...	...	2	...	1

TABLE III (*continued*).

NAMES OF FOREIGN SEED.	KIND OF CROP SEED.									
	Alfalfa.	Red clover.	Timothy.	Alsike clover.	Alsike and timothy mixture.	Redtop.	Hairy vetch.	White clover.	Kentucky blue grass.	Miscellaneous samples.
Number of samples examined	621	170	150	96	17	14	14	13	14	31
Cow herb (*Saponaria vaccaria* L.)	2	11	5	1	3	...	...	...	...	...
Crab-grass, small (*Digitaria humifusa* Pers.)	2	11	5	1	3	...	...	...	...	...
Crab-grass, large (*Digitaria sanguinalis* L.)	1	4	...	...	...	...	...	...	...	...
Cranesbill (*Geranium carolinianum* L.)	1	1	...	...	...	...	...	...	...	...
Cranesbill (*Geranium dissectum* L.)	2	18	...	...	...	...	...	...	...	2
Cranesbill (*Geranium pusillum* Burm.)	2	8	...	...	...	...	...	...	...	...
Crimson clover (*Trifolium incarnatum* L.)	...	2	...	...	...	...	...	...	...	...
Dandelion (*Taraxacum erythrospermum* Andrz.)	...	...	...	...	...	...	...	...	...	1
Darnel (*Lolium multiflorum* Lam.)	...	2	...	...	...	...	...	...	...	...
Dock, curled (*Rumex crispus* L.)	71	130	1	1	...	...	...	...	...	...
Dock (*Rumex* spp.)	2	...	13	37	6	...	...	2	3	6
Dodder, clover (*Cuscuta epithymum* Murr.)	43	11	...	...	1	...	...	...	...	...
Dodder, field (*Cuscuta arvensis* Beyrich.)	41	22	...	...	...	...	...	...	...	...
Ergot (Sclerotia) (*Claviceps* sp.)	...	...	4	...	2	1	...	...	...	...
Euphorbia spp	1	...	...	...	...	...	...	...	...	...
Evening primrose (*Onagra biennis* (L.) Scop.)	...	1	9	...	2	1	...	...	...	...
False flax (*Camelina microcarpa* Andrz.)	1	1	7	8	5	...	...	...	...	2
False flax (*Camelina sativa* (L.) Crantz.)	5	...	1	2	1	...	...	...	...	3
Foxtail, green (*Chaetochloa viridis* (L.) Nash.)	315	142	25	23	5	...	...	2	...	4
Foxtail, yellow (*Chaetochloa glauca* (L.) Scrib.)	57	40	...	...	...	...	...	...	...	...
Galium sp	2	...	...	...	...	...	...	...	...	...
Grass (*Poaceae* spp.)	49	21	16	8	1	...	...	1	..	3
Gum plant (*Grindelia squarrosa* (Pursh) Dunal)	8	...	...	...	...	...	...	...	...	...
Hare's ear (*Conringia orientalis* (L.) Dumort)	6	2	...	...	...	...	...	...	...	1
Heal-all (*Prunella vulgaris* L.)	14	65	12	12	2	...	...	1	...	1
Hedge mustard (*Sisymbrium officinale* L.)	...	...	2	1	...	1	...	...	...	2
Hoary cress (*Lepidium draba* L.)	2	...	...	...	...	...	...	...	...	...
Johnson grass (*Sorghum halepense* (L.) Pers.)	14	3	...	...	...	...	...	...	...	...
Kidney vetch (*Anthyllis vulneraria* L.)	2	...	...	...	...	...	...	...	...	...
Knot grass (*Polygonum aviculare* L.)	10	5	...	...	...	...	...	...	...	...
Lady's thumb (*Polygonum persicaria* L.)	4	33	...	...	...	...	...	8	...	2
Lamb's quarters (*Chenopodium album* L.)	187	57	33	10	4	...	...	...	...	1
Lentil (*Ervum lens* L.)	...	...	...	...	...	...	1	...	...	...
Mallow (*Malva rotundifolia* L.)	51	8	...	...	...	...	...	...	...	...
Mallow, false (*Malvastrum coccineum* Gray)	3	...	...	...	...	...	...	...	...	...
Mallow, whorled (*Malva verticillata* L.)	2	...	...	...	...	...	...	...	...	...
Malva sp	2	...	...	...	...	...	...	...	...	...

TABLE III (*continued*).

NAMES OF FOREIGN SEED.	KIND OF CROP SEED.									
	Alfalfa.	Red clover.	Timothy.	Alsike clover.	Alsike and timothy mixture.	Redtop.	Hairy vetch.	White clover.	Kentucky blue grass.	Miscellaneous samples.
Number of samples examined	621	170	150	96	17	14	14	13	14	31
Maple-leaved goose foot (*Chenopodium hybridum* L.)	9									
Marsh elder (*Iva xanthifolia* (Fresn.) Nutt.)	25	1								
Marsh spike grass (*Uniola latifolia* Michx.)	1									
May weed (*Anthemis cotula* L.)		12	4	7	4	1		1		1
Meadow fescue (*Festuca elatior* L.)		1								
Melilotus spp	6									
Melilotus, slender (*Melilotus gracilis* D. C.)	1									
Millet (*Chaetochloa italica* (L.) Beauv.)	50	5	1		1					2
Moth mullein (*Verbascum blattaria* L.)			1							
Mustard (*Brassica* spp.)	105	20	1	3			1			7
Mustard, black (*Brassica nigra* (L.) Koch.)	6									
Mustard, tumble (*Sisymbrium altissimum* L.)	1									
Mouse-ear chickweed (*Cerastium vulgatum* L.)			8	5	2	1		1	2	2
Narrow-leaved hawk's-beard (*Crepis tectorum* L.)										1
Niger seed (*Guizotia abyssinica* Cass.)			1							
Night-flowering catchfly (*Silene noctiflora* L.)	25	49	10	36	5			9		3
Old witch grass (*Panicum capillare* L.)	7	10	2	3	5			1		
Oxeye daisy (*Chrysanthemum leucanthemum* L.)	3		14	12	2	1				2
Paspalum (*Paspalum setaceum* Michx.)	7	4								
Penny cress (*Thlaspi arvense* L.)	1									
Pepper-grass, apetalous (*Lepidium campestre* (L.) R. Br.)	1	10	1	7	1					
Pepper-grass, wild (*Lepidium virginicum* L.)	5	3	67	11	11	3		2	6	1
Picris (*Picris hieracioides* L.)	10	22								
Picris; oxtongue (*Picris echoides* L.)	11	33								
Pigweed (*Amaranthus* spp.)	109	11	1	7	4			3	2	3
Pigweed, slender (*Amaranthus hybridus* L.)	11	30								
Pigweed, rough (*Amaranthus retroflexus* L.)	1	1	22							
Pimpernel (*Anagallis arvensis* L.)		1								
Plantain, buckhorn (*Plantago lanceolata* L.)	163	137	26	51	15	3		8	5	7
Plantain, Rugels (*Plantago rugelii* Decne.)		32	25	6	6	5		3		2
Plantain, broad-leaved (*Plantago major* L.)	2	21	14	3	9				1	1
Plantain, large-bracted (*Plantago aristata* Michx.)		21								
Poison hemlock (*Conium maculatum* L.)	2									
Polygonum spp	34	18								

TABLE III (*continued*).

NAMES OF FOREIGN SEED.	KIND OF CROP SEED.									
	Alfalfa.	Red clover.	Timothy.	Alsike clover.	Alsike and timothy mixture.	Redtop.	Hairy vetch.	White clover.	Kentucky blue grass.	Miscellaneous samples.
Number of samples examined	621	170	150	96	17	14	14	13	14	31
Prostrate amaranth (*Amaranthus blitoides* S. Wats.)	11	1	...	...	...	...	...	...	...	...
Ragweed (*Ambrosia artemisiifolia* L.)	14	33	...	...	...	...	...	...	...	...
Red clover (*Trifolium pratense* L.)	61	...	54	61	7	1	...	7	1	2
Redtop (*Agrotis alba* L.)	7	...	17	9	13	...	...	1	...	3
Roquette (*Eruca sativa* Mill.)	29	...	...	...	...	...	...	...	...	...
Rush (*Juncus tenuis* Willd.)	...	...	...	...	...	5	...	...	...	...
Russian thistle (*Salsola kali tenuifolia* G. F. W. Mey.)	89	6	...	...	...	...	...	...	...	...
Rye (*Secale cereale* L.)	1	1	...	...	...	...	...	...	...	...
Sage, lance-leaved (*Salvia lanceaefolia* Poir.)	9	1	...	...	...	...	...	...	...	...
Sage, lyre-leaved (*Salvia lyrata* L.)	3	...	...	...	...	...	...	...	...	...
Salt bush; Orache (*Atriplex patula* L.)	117	3	2	...	...	...	...	...	...	...
Sand bur (*Cenchrus tribuloides* L.)	4	...	...	...	...	...	...	...	...	...
Serradella (*Ornithopus sativus* Butt.)	2	1	...	...	...	...	...	...	...	...
Sedge (*Carex* spp.)	5	7	26	4	12	4	...	2	14	2
Sheep sorrel (*Rumex acetosella* L.)	15	73	70	58	16	3	...	13	10	8
Shepherd's purse (*Capsella bursa-pastoris* (L.) Medic.)	1	1	3	4	...	...	...	3	1	...
Slender nettle (*Urtica gracilis* Ait.)	...	...	1	...	...	...	...	1	...	1
Smart-weed (*Polygonum hydropiper* L.)	7	9	...	...	...	...	...	...	...	...
Sorrel (*Rumex acetosa* L.)	5	...	...	...	...	...	...	...	...	...
Spring vetch (*Vicia sativa* L.)	...	...	...	...	...	...	12	...	...	...
Spurry (*Spergula arvensis* L.)	1	1	1	...	...	...	...	4	...	...
St. John's wort (*Hypericum perforatum* L.)	...	...	...	...	3	...	...	...	...	...
Star thistle (*Centaurea cyanus* L.)	1	...	...	...	...	...	...	...	...	...
Star thistle (*Centaurea jacea* L.)	6	4	...	...	...	...	...	...	...	...
Star thistle (*Centaurea picris* L.)	5	...	...	...	...	...	...	...	...	...
Star thistle (*Centaurea repens* L.)	50	2	...	...	...	...	...	...	...	...
Star thistle (*Centaurea solstitialis* L.)	5	3	...	1	...	...	...	...	...	...
Sow thistle (*Sonchus oleraceus* L.)	...	...	...	1	...	...	...	...	...	...
Stick-seed (*Lappula echinata* Gilibert)	14	17	...	3	...	...	...	...	...	...
Stink-grass (*Eragrostis megastachya* Link.)	1	...	...	...	...	...	...	...	...	...
Sulla (*Hedysarium coronaria* (Tourn.) L.)	5	...	...	...	...	...	...	...	...	...
Sweet clover (*Melilotus alba* Desr.)	63	2	...	...	...	...	...	...	...	...
Switch grass (*Panicum virgatum* L.)	2	...	...	...	...	...	...	...	...	...
Timothy (*Phleum pratense* L.)	101	68	...	84	...	9	...	5	...	9
Trionema monogyna L.	6	...	...	...	...	...	...	...	...	...
Vervain, blue (*Verbena hastata* L.)	...	11	1	...	...	1	...	...	...	...
Vervain, white (*Verbena urticifolia* L.)	...	1	1	...	1	...	...	...	...	...

TABLE III (*concluded*).

NAMES OF FOREIGN SEED.	KIND OF CROP SEED.									
	Alfalfa.	Red clover.	Timothy.	Alsike clover.	Alsike and timothy mixture.	Redtop.	Hairy vetch.	White clover.	Kentucky blue grass.	Miscellaneous samples.
Number of samples examined	621	170	150	96	17	14	14	13	14	31
White clover (*Trifolium repens* L.)	15	35	34	69	8	4	...	...	7	5
White hoarhound (*Marrubium vulgare* L.)	1	...	...	...	...	...	...	...	...	...
Wild buckwheat (*Polygonum convolvulus* L.)	5	3	...	...	...	...	...	...	...	...
Wild carrot (*Daucus carota* L.)	25	40	...	3	...	...	...	...	...	2
Wild lettuce (*Lactuca canadensis* L.)	1	...	...	...	...	1	...	...	...	...
Wild radish (*Raphanus raphanistrum* L.)	1	...	1	...	...	1	...	...	...	1
Wild vetch (*Lotus americanus* (Nutt.) Bisch.)	...	...	...	...	...	...	1	...	...	4
Willow herb (*Epilobum angustifolium* L.)	...	...	8	...	1	1	...	...	...	...
Yarrow (*Achillea millefolium* L.)	1	8	2	1	2	3	...	...	...	...
Yellow chamomile (*Anthemis tinctoria* L.)	...	...	...	1	...	...	...	...	...	...
Yellow rocket (*Barbarea barbarea* (L.) MacM.)	1	2	4	11	1	...	...	1	...	...

NOTES ON PRECEDING TABLE.

The bulk of the weed-seed impurities of commercial seeds consists chiefly of well known established weeds, yet such commercial seed is the natural channel for the introduction of other weeds less well known in New York. This is especially true of imported seed or seed from the western states. From a study of the preceding table, and the work bearing directly upon the subject the following observations regarding some old and new weeds are made:

Dodder.— Both small-seeded and large-seeded dodder occurred in samples of alfalfa and red clover. Thirteen per ct. of the alfalfa samples were found to contain dodder seed varying in amounts from a few seeds to a pound of alfalfa seed to 2 per ct. dodder seed, as was found to be the case in one sample. In this it seemed evident that this large amount of dodder seed had been intro-

duced by the addition of screenings. In two samples of alfalfa, seeds of small-seeded dodder were found to be present, enclosed in the capsules. These dodder seeds could not be removed by the use of a sieve recommended for the separation of such seeds from alfalfa, until the capsules were crushed or broken apart thus allowing the seeds to escape. The percentage of alfalfa samples containing dodder was slightly higher than in previous years, and about one-half of the dodder-infested samples contained large-seeded dodder which cannot be removed by the use of a dodder sieve.

Over 19 per ct. of the samples of red clover contained dodder, of which two-thirds contained the large-seeded dodder. This is a decided increase in percentage of dodder-infested clover samples as compared with 5 per ct. reported in 1911.

The increase in the percentage of dodder-infested samples and the experience of farmers during the past season with this pest calls for a note of warning to prospective purchasers, as it is considered unwise to sow seed containing even one seed of dodder per pound of crop seed. Cheap seed, with respect to dodder, should be avoided, as it invariably proves costly in the end.

Mustard.— The seed of this noxious weed occurred in 112, or 18 per ct., of the alfalfa samples, and in 20, or 12 per ct., of the samples of red clover.

Plantain, or buckhorn.— The seed of this pest was found in 80 per ct. of the red clover samples, and in 26 per ct. of the alfalfa samples.

Green foxtail.— The seed of this grass was the most common impurity found in red clover since it occurred in 82 per ct. of the samples examined. It occurred in 50 per ct. of the alfalfa samples.

Chicory.— Ten per ct. of the alfalfa samples, and 16 per ct. of the red clover samples contained the seeds of this weed as an impurity and in some cases to a very noticeable extent. It is very evident that this pest in most cases invades the farm through the use of impure grass or clover seed.

Curled dock.— The seed of this common weed occurred in 11 per ct. of the samples of alfalfa and in 70 per ct. of the red clover samples. The statement that this weed is introduced by the use of impure seed is borne out by the presence of the seed in so many of the samples examined.

Russian thistle.— Nearly 15 per ct. of the alfalfa samples contained seeds of this weed. In addition to its occurrence in seed samples, specimens of the plant have been sent in for identification, and upon investigation as to the behavior of this weed in the alfalfa fields of the State it was found that in no case did it appear after the first year following seeding. Apparently, it is very susceptible to frost and when it starts in late summer with the alfalfa seeding the plants are destroyed before they produce seed. It is, therefore, considered to be a weed of no great importance in the alfalfa field.

Roquette.— Of the 614 samples of alfalfa, 28 contained seed of this weed, and several specimens of the plant were sent in for identification. An investigation of each occurrence of the weed revealed the fact that, like Russian thistle, it did not appear after the first year, and is not to be feared by alfalfa growers; but it should not be allowed to ripen its seeds in cultivated crops. The plant is a hairy annual, which resembles wild mustard, and is easily identified by its yellowish-white, aromatic flowers which are netted with dark purple veins. Its flavor is very bitter and pungent, or radish-like.

Johnson grass.— The seed of this grass occurred in 14 alfalfa and in 3 red clover samples. In addition to its occurrence in seed samples, some inquiries as to its probable importance have been received. It has not been met with in alfalfa fields as yet, and no specimens have been received for identification.

Yellow trefoil; black medick.— The seed of this plant was found in 12 samples of alfalfa, and in 16 per ct. of the red clover samples, and also in 40 per ct. of the samples of alsike clover. The presence of this seed in such a large percentage of the alsike clover samples is probably due to natural infestation in the field;

however, adulteration may have occurred in some cases. A number of specimens of this plant have been received for identification during the past season which would indicate that it is quite generally prevalent in alfalfa and clover fields. This plant is of little value except as a pasture plant, and when it is found in alsike or red clover seed it is treated as a weed inasmuch as it ripens early and is hard and woody when clovers are ready to cut.

COMMENTS ON THE SEED SAMPLES.

Alfalfa.—A large percentage of the alfalfa samples were of good to excellent quality, both as regards general appearance and purity; but some were below average and a few samples were notoriously poor, being badly contaminated with weed seed and also containing much dead, brown, shriveled and immature seed which would make them expensive at any price. The presence of *Centaurea repens* in 38 of the samples would tend to indicate that the seed was imported. While imported and Turkestan seed has given good results in some cases in this State, it is considered advisable to secure the common variety.

Red clover.— Results of examination of the 169 samples of red clover show that it still maintains its bad reputation as regards weed impurities. The number and amount of impurities is greater than reported last year, and the number of dodder-infested samples was decidedly higher.

Timothy.— The quality of the 148 samples of timothy was found to be good to excellent in most cases, but occasionally a sample would be received in which a large number of weed seeds occurred, often swelling the long list of impurities. The principal impurities were Canada thistle, dock, plantain, sheep sorrel, and oxeye daisy.

Alsike clover.— The 94 samples of alsike clover showed a considerable number of impurities; however, the greater percentage of the samples were marked average to good. A few samples contained considerable seed of Canada thistle, dock, plantain, catchfly, sheep sorrel, yellow trefoil and white clover. Timothy was

found in varying amounts in 88 per ct. of the samples, and, in some cases, in considerable quantity. While timothy is not especially objectionable in alsike, few farmers care to pay alsike prices for timothy seed.

Alsike and timothy mixtures.—An examination of the 17 samples of this mixture revealed a surprising condition as regards both quality and purity. Every sample was graded as poor to very poor, due to the seed being poorly colored, shriveled and of light weight, and very badly contaminated with weed seed and inert matter. Several of the samples were found to contain approximately 63 per ct. of timothy seed, 25 per ct. poor-quality alsike clover seed, and 12 per ct. weed seeds and inert matter. Farmers should be warned against such mixtures, as it has been found more satisfactory to buy the pure seed and then mix them upon the farm when mixtures are desired.

Redtop.— The quality of the 14 samples of redtop was generally good, most of the seed being recleaned and of good weight. Very few impurities were present.

Hairy vetch.— With the increasing demand made by fruit growers for this legume as a cover crop comes the tendency of some dealers to adulterate the seed with that of common or spring vetch. Our examinations revealed the fact that 12 of the 14 samples contained the seed of spring vetch — in one case to the extent of 25 per ct., and in another sample to the extent of 20 per ct. This fact supplemented by the experience of orchardists of this State with the adulteration of this crop seed calls for a note of warning to prospective buyers.*

White clover.— With the exception of the presence of sheep sorrel, lamb's quarters and plantain seed, the 12 samples of white clover were comparatively free from many impurities. The seed in several of the samples was badly shrunken and shriveled so that all of the samples were necessarily marked average to poor in quality.

*For a complete description of this important cover crop and annual winter legume, and its seed adulterants, the reader is referred to U. S. Dept. Agr. Farmers' Bulletin No. 515, by C. V. Piper, Roland McKee and F. H. Hillman.

Kentucky blue grass.— Five of the 13 samples of this seed were graded as excellent, 6 average quality, while 2 samples were of poor quality, consisting of light weight seed which was badly contaminated with seed of sheep sorrel, pepper-grass, white clover and a species of sedge. Two of the samples contained a small quantity of Canada blue grass.

Lawn mixtures.— Two samples labeled as lawn mixtures were received and analysis showed them to be of very poor quality, being made up of poor seed which was badly mixed with weed seeds representing 14 kinds of bad lawn weeds.

Miscellaneous samples.— No definite statements can be made as to the general quality of the crop seeds represented by the 31 miscellaneous samples, since only one or two samples of each kind were received in some cases and possibly do not represent the general average quality of the seed. The kind and number of miscellaneous samples examined is as follows: Buckwheat 1, Canada blue grass 6, crimson clover 6, dogs-tail grass 1, millet 1, orchard grass 7, rape 2, spring vetch 1, sweet clover 3, turnip 1.

Wheat screenings.—A large sample of wheat screenings representing a quantity of the material bought for the purpose of feeding to live stock was received and when examined was found to contain 46 per ct. of weed seed, representing many kinds, notably flax, pigeon grass, mustard, wild oats and wild buckwheat. The remaining 54 per ct. of the sample consisted of sand, chaff, wheat straw joints and shriveled kernels of wheat. Such material is the means of introducing a large number of bad weeds upon the farm.

THE PERSISTENCE OF THE POTATO LATE-BLIGHT FUNGUS IN THE SOIL.*

F. C. STEWART.

SUMMARY.

This bulletin contains an account of some experiments the object of which was to determine whether the fungus which causes the late blight and rot of potatoes, *Phytophthora infestans,* lives over winter in the soil. Boxes of soil containing blighted potato vines and decaying tubers were left in the field exposed to the weather until January 20, when they were transferred to a greenhouse and planted with potatoes. Some of the resulting plants were placed in a glass inoculation chamber and inoculated repeatedly by sprinkling or brushing the foliage with an infusion of the soil containing the decaying potato tubers and stems. Meanwhile, the air in the inoculation chamber was kept constantly at or near the point of saturation. Notwithstanding the conditions were extremely favorable for infection no Phytophthora appeared either on the leaves or tubers. The conclusion reached is, that while the negative results of these experiments do not prove that Phytophthora does not persist in the soil they make such persistence appear highly improbable.

THE PROBLEM.

Does the potato blight fungus, *Phytophthora infestans*, persist in the soil from one season to the next? Is it safe to plant potatoes where potatoes blighted and rotted the previous year? These questions are frequently asked by potato growers. In giving an answer it should be stated, first of all, that there are different kinds of potato blight and rot. The Fusarium wilt and the tuber rot which accompanies it certainly do persist in the soil; while the dry weather blight, called tip burn, does not persist. The fungus of early blight, *Alternaria solani*, probably survives the winter in the soil, but definite proof is lacking. Of course, it is the late blight and rot,

* Reprint of Bulletin No. 367, October, 1913; for Popular Edition, see p. 770.

caused by the fungus *Phytophthora infestans*, which is the chief concern of potato growers in this connection and it is with this disease that the present bulletin has to do.

Although considerable has been written upon the subject it seems unnecessary to give a detailed review of the literature here. It is sufficient, perhaps, to say that while evidence both for and against the persistence of Phytophthora has been produced the view that it does not persist has been the prevailing one. However, Massee, an English mycologist, makes the following remarkable statement:[1] "I have observed the important fact that, when diseased potatoes are planted, after the crop has been lifted, the remains of the old seed potatoes, when brought to the surface of the ground, will produce a crop of the fungus bearing myriads of spores. If such old seed potatoes are kept buried in soil until the following year, and then exposed to light under favorable conditions, fungus fruit is still produced, and continues to grow so long as a scrap of the old potato remains. I have now in the laboratory at Kew gardens scraps of last year's seed potatoes covered with the fungus, and with the spores thus produced have successfully inoculated the leaves of young potato plants. * * * * In all probability the fungus is always present in land where potatoes are grown at short intervals." Massee even goes so far as to recommend gathering and destroying the diseased tubers as a means of controlling the disease. Clinton, who made field studies in Connecticut, says:[2] "We do not wish to state positively, from these observations, that the blight starts earlier and more vigorously in a field that bore a blight-diseased crop the year before, as such factors as situation of the land, earliness of planting, etc., may need consideration here, but so far as they go they seem to point to this conclusion." Clinton's subsequent discovery of the resting spores (oöspores) of the blight fungus[3] tends to support the theory that the fungus may persist in the soil, but it is still unknown how frequently oöspores are formed in nature or what part they play in primary infection.

[1] Massee, George. Some diseases of the potato. *Jour. Roy. Hort. Soc.* 19:139. 1904.

[2] Clinton, G. P. Report of the Botanist. Conn. Sta. Rpt. for the Year 1905, Part 5, p. 311. 1906.

[3] Clinton, G. P. Oöspores of potato blight. *Science* 33: 744–747. 12 May, 1911. *Ibid.* Oöspores of potato blight, *Phytophthora infestans*. Conn. Sta. Rpt. for 1909 and 1910. Part 10, pp. 753–774. Je., 1911.

THE EXPERIMENTS.

The writer has sought to solve the problem by greenhouse experiments which will now be described:

Experiment No. 1. In the autumn of 1910 ten wooden boxes of 1350 cubic inches capacity were partially filled with soil from a field in which a large portion of the potato crop of that season had been destroyed by Phytophthora rot. Twelve large partially-decayed tubers and a quantity of blighted potato stems cut into short sections were then placed in each box and the filling of the boxes completed by adding more of the soil. The boxes were left in the field exposed to the weather until January 20, 1911, when they were placed in a greenhouse. Tubers for planting in the boxes were obtained from eastern Long Island, where potatoes were not affected by Phytophthora in 1910. Previous to planting, the tubers were washed, carefully examined for blemishes and given the formaldehyde scab treatment. In each box the decaying tubers were broken into pieces, which were thoroughly mixed with the soil. Eight of the boxes were planted February 1, while the other two were reserved for making soil filtrate for inoculation. From this time until the plants were nearly full-grown the soil in the boxes was kept constantly wet by watering nearly every day. On March 22 the plants were 10 to 12 inches high, bushy and very thrifty. On this date the largest and thriftiest of the plants was placed in a large glass inoculation chamber in which the air was kept constantly at or near the point of saturation by frequent watering. The leaves were wet most of the time. The plant grew rapidly. By March 31 several of the lower leaves had turned yellow, as they do in the field when the weather is wet and the vines large. On April 19 some of the younger leaves showed an œdematous eruption on the upper surface along the midrib and larger veins. The conditions must have been ideal for Phytophthora, yet none appeared up to April 25, when the plant was removed from the inoculation chamber and another one put in its place.

The new plant had several stalks about 18 inches high and its foliage was nearly perfect. It was heavily watered at noon on April 25, and at 2:30 p. m. of the same day its foliage was sprinkled thoroughly with a soil filtrate prepared by stirring up a quantity of the potato soil with water and filtering through cheesecloth. The soil used contained the remains of decayed potatoes and potato stems.

During the next ten days the leaves were kept constantly moi As no sign of Phytophthora appeared, a second attempt at inocu tion was made on May 4 by sprinkling the leaves with a soil filtr prepared as before from soil from one of the boxes containing t remains of decayed tubers and potato stems. This, also, ga negative results. Some of the leaves turned yellow and decaye but no Phytophthora appeared. The experiment was closed May 1 None of the plants in the open greenhouse showed any indicati of Phytophthora either on leaves or tubers.

Experiment No. 2. This experiment was, essentially, a repetiti of Experiment No. 1, though differing from it in some of the detai In October, 1912, seven boxes were filled with soil and rotti potatoes from a field in which late blight and rot had been ve destructive. First, a layer of about two inches of soil was placed the bottom of each box, then a layer of potato stems followed by layer of rotting tubers, and, lastly, another layer of soil. The box were left in the open field exposed to freezing and thawing un January 20, 1913, when they were placed in a greenhouse. Se tubers known to be free from Phytophthora were obtained fro Riverhead, Long Island. After being washed and disinfected wi formaldehyde solution these tubers were planted in six of the box on February 1. Previous to planting, the soil and decaying tub and potato stems had been thoroughly mixed. Although some the decaying tubers still retained their form all were so far advan in decay that no growth of sprouts was possible. They could readily pulled apart with the fingers. One of the boxes was pla at once in the inoculation chamber. The plant in this box gr rapidly. By March 19 it had three stalks 20 inches high. T leaves were large and perfect except for some [illegible] growths along the midribs of some of the leaves. They appea to be in excellent condition for infection by Phytophthora. T first attempt at infection was made March 1[illegible] the second [illegible] and a third on April 1. Each time the [illegible] coated (some on the upper and some on the lower [illegible] mud prepared by stirring up the mixture of [illegible] material in a small quantity of water [illegible] parts by squeezing with the hands. [illegible] brush. The plant was [illegible] that it remained in the moist chamber [illegible] upon it.

On April 10 a second plant was placed in the inoculation chamber. It was inoculated twice (April 10 and 16) in the same manner as its predecessor and kept constantly wet for 27 days, but it showed no Phytophthora. Neither did the other four plants in the open greenhouse.

CONCLUSIONS.

The negative results of these experiments do not prove that *Phytophthora infestans* does not persist in the soil, but they make such persistence appear highly improbable. With such an abundance of rotten potatoes and with moisture conditions so favorable for infection it is surely remarkable that no infection occurred if there was anything in the soil or potatoes capable of producing infection.

However, so far as the control of blight and rot is concerned it really does not matter much whether the fungus does or does not persist in the soil. In any case, blight and rot can be controlled by proper spraying and, in New York, at least, the necessity of spraying can not be avoided by any method of crop rotation or by planting disease-free seed. Numerous experiments made in this State have shown that although spraying may occasionally prove unprofitable, particularly in dry seasons, it is highly profitable on the average.[4] The spraying of late potatoes should never be neglected.

While the planting of potatoes after potatoes has a tendency to increase trouble with scab, Fusarium wilt and some other diseases, and is often inadvisable for other reasons, there is no risk in the practice so far as late blight and rot are concerned.

The removal of diseased tubers from the field, as recommended by Massee, we regard as unnecessary.

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[4] The experimental evidence on which this statement is based, also, directions for spraying, will be found in Bulletin No. 347 of this Station.

THE INJURIOUS EFFECT OF FORMALDEHYDE GAS ON POTATO TUBERS.*

F. C. STEWART AND W. O. GLOYER.

SUMMARY.

In treating a quantity of seed potatoes with formaldehyde gas for scab at the Station in the spring of 1912, many of them were so severely injured that they were unfit for seed. The injury took the form of sunken brown spots surrounding the lenticels and eyes. The gas was generated by the permanganate method, using the standard formula of 3 pints of formaldehyde solution and 23 ounces of potassium permanganate to each 1000 cubic feet of space. An investigation into the cause of the injury placed the blame chiefly upon the small quantity (1.5 lbs.) of potatoes per cubic foot of space in the fumigation chamber. The high relative humidity of the air and the sprouted condition of the potatoes were important accessories. By the property of adsorption the potatoes seize and hold the formaldehyde gas upon their surface. If there are but few potatoes they adsorb so much gas that the tissue is injured; but when the gas is distributed over a large quantity of potatoes it does not gather at any point in sufficient quantity to cause injury. In our experiments various degrees of lenticel spotting occurred with all quantities up to 12 lbs. per cubic foot, but no eye injury appeared when 5 lbs. or more per cubic foot were used. The effect of lenticel spotting on germination and growth have not been fully determined, but it is believed that there may be considerable lenticel spotting without material injury to the tubers for seed purposes. The gas treatment is to be recommended only in cases in which the liquid treatment is impracticable. With the gas treatment it is evident that in order to secure uniform results the quantity of the chemicals must be varied according to the quantity of potatoes per cubic foot of space, but further experiments are required to determine just how it should be done. At present, the only formula which can be recommended as being both safe and efficient for scab is that of 3 pints of formaldehyde and 23 ounces of permanganate to 167 bushels of potatoes in 1000 cubic feet of space.

* Reprint of Bulletin No. 369; for Popular Edition, see p. 774.

Similar spotting of potato tubers results from exposure to the fumes of ammonia, bromine or ether, and from dipping or soaking in strong solutions of corrosive sublimate and formaldehyde. However, in the use of formaldehyde solution the quantity of potatoes treated has no appreciable influence on the degree of the injury. The same solution may be used at least ten times without loss of strength.

Rome, and some other varieties of apples, when injured by formaldehyde gas show, chiefly, lenticel spotting, while on Baldwin the injury usually appears as a browning of the skin resembling scald.

ORIGIN AND DEVELOPMENT OF THE FORMALDEHYDE GAS TREATMENT.

The germicidal properties of formaldehyde solution were discovered by Loew [1] in 1888. During the next decade it came into wide use as a disinfectant and antiseptic.[2] Its use on seed potatoes as a preventive of scab (*Oöspora scabies* Thax.) originated with Dr. Arthur [3] of the Indiana Experiment Station in 1897. The method of treatment which he recommended is widely used and everywhere recognized as the standard. Simultaneously with the rise of formaldehyde solution as a disinfectant there came the use of formaldehyde gas for similar purposes. Being non-poisonous and harmless to metals and fabrics it soon became popular for the disinfection of rooms in which cases of contagious disease had occurred.[4] Several methods of generating the gas were employed. In 1904, the discovery of an improved method, called the formalin-permanganate method, was announced by Evans and Russell.[5] This consists in pouring a solution of formaldehyde over crystals of potassium permanganate. In the resulting chemical reaction a large amount of formaldehyde gas is liberated in the course of a few minutes. The chief merits

[1] Loew, O. Physiologische Notizen über Formaldehyd. Ber. Gesell. Morph. u. Phys. zu München, 1888.

[2] For the literature of this period see the bibliography appended to Arthur's paper in Ind. Sta. Bul. 65.

[3] Arthur, J. C. Formalin for prevention of potato scab. Ind. Sta. Bul. 65. 1897.

[4] The literature of formaldehyde disinfection prior to 1901 has been collected by Reischauer (*Hyg. Rundschau* 11: 636).

[5] Evans, H. D. and Russell, J. P. Formaldehyde disinfection. Me. State Bd. of Health Rpt. 13. 1904. Reprint.

of the method are three: (1) Simplicity; (2) freedom from danger of fire; and (3) the rapidity with which the gas is liberated.

From 1900 to 1905 Jones and Morse,[6] at the Vermont Experiment Station, experimented with the disinfection of seed potatoes by means of formaldehyde gas. In their early experiments the gas was generated by evaporating formaldehyde solution over a flame, but in 1905 they used the (then) new formalin-permanganate method with promising results. In Bulletin No. 141 of the Maine Station, published in March, 1907, Morse recommends the following treatment as applicable where a large quantity of seed potatoes is to be treated: "Place seed potatoes in bushel crates or shallow slat-work bins in a tight room. For each 1000 cubic feet of space spread 23 ounces of potassium permanganate evenly over the bottom of a large, flaring pan or pail placed in the middle of the room. Pour over this three pints of formalin. Close room at once and do not open for 24 to 48 hours."

In a later bulletin Morse[7] reports an experiment in which the above treatment was successfully applied on a commercial scale. He also relates the experience of a man who injured several barrels of tubers severely by placing the generator directly underneath and only a few inches below a large slat-work bin containing the potatoes to be treated. Morse obtained similar results experimentally. This led him to advise that "no potatoes should be placed directly above the generator." In the same place he writes as follows concerning the danger of injury:[8] "Five years of experience in treating potatoes with formaldehyde gas generated in various ways indicate that, if properly handled, the gas from 3 pints of 40 per ct. formaldehyde may be safely used to the 1000 cubic feet of space. In fact over 3 quarts to the 1000 cubic feet have been used repeatedly without injuring the germinating qualities of the tubers in the least."

Two years later the same writer again published directions for the gas treatment.[9] This time it was stated that "the disinfection with formaldehyde gas should be done before the sprouts begin to start on the seed tubers." The safety of the treatment, if made according to directions, was reiterated.

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[6] Vt. Sta. Rpt. 13 : 281; 14 : 232; 15 : 227; 16 : 166; 17 : 397; 18 : 287.
[7] Morse, W. J. Potato diseases in 1907. Me. Sta. Bul. 149. 1907.
[8] *Loc. cit.* p. 314.
[9] Morse, W. J. Blackleg: a bacterial disease of the Irish potato. Me. Sta. Bul. 174. 1909.

A PERPLEXING CASE OF INJURY.

In the spring of 1912 the writers undertook, for the first time, the disinfection of a quantity of seed potatoes in the manner recommended by Morse. The room used was a cellar 31.4 x 13.3 x 8.4 feet with a content of 3508 cubic feet. The floor and walls were of cement. The ceiling was airtight and the two windows nearly so, but around the door there was some opportunity for leakage of gas. At the time of treatment the cellar contained 87 bushels of potatoes and four bushels of apples. The potatoes were in slatted bushel crates piled two and three deep and arranged so as to permit of the free circulation of the gas about them on all sides except the top and bottom. Three generators were used. Two were large tin dishpans and the third a bushel measure of galvanized iron. They were placed on the floor, at equal distances apart, through the center of the cellar.

Each of the two dishpans was charged with 23 ounces of potassium permanganate crystals and 3 pints of 40 per ct. formaldehyde solution, while the bushel measure contained 35 ounces of potassium permanganate and 4.5 pints of formaldehyde. The total weight of permanganate was 81 ounces and the total quantity of formaldehyde 10.5 pints. Thus the chemicals were used in almost exactly the quantity and proportions recommended by Morse. The crates of potatoes were so disposed that none were nearer than 2.5 feet to a generator and none farther away than about 8 feet. The floor of the cellar was wet and the walls and ceiling damp with drops of condensed moisture. The humidity is not known but it must have been high. The temperature was about 45 degrees Fahr. The generators were started and the door closed at 2:30 P. M., May 1. Twenty-six hours later the door was opened and left open. At 8:30 A. M. on May 3 (16 hours after opening the door) the gas was still so strong in the back part of the cellar that one could not stay there more than a few minutes at a time. Accordingly, the windows were opened and a circulation of air secured. It must be that practically all of the gas was removed within 48 hours of the time of starting the generators. It appears that the dishpans were too small or too shallow since some of the residue was found on the floor around them after the cellar was opened.

On May 7 the writers were much surprised to find that the treatment had resulted in serious injury to some of the tubers, particularly

those most exposed on the surface of the top crates. The injury appeared in the form of sunken brown spots of various shapes and all sizes from a mere speck to about one-half inch in diameter. Sometimes larger spots were formed by the coalescence of two or more small spots. Many spots were circular with a lenticel at the center. Frequently, the eyes were surrounded by circular sunken areas of brown dead tissue. On many tubers as much as one-half of the total surface area was covered by the spots. Although the spots, particularly the larger ones, were conspicuously sunken, the layer of dead, brown tissue lining the depression was usually only one or two millimeters in thickness. It was rarely more than 3 millimeters thick. In one of the top crates containing 213 tubers 56 were so much injured as to be unfit for seed. In another top crate 67 per ct. of the tubers were more or less spotted while in the crate just beneath only 12 per ct. were spotted. The tubers in the entire 40 top crates were carefully sorted and 10 bushels, or 25 per ct., which showed more or less eye injury were rejected as unfit for seed. Apparently, the tubers in the lower crates were not sufficiently injured to materially affect their germination. However, it should be stated that where these potatoes were planted a very poor stand was obtained. This, we believe, was due to unfavorable soil and weather conditions rather than to any weakness of the seed. Even the worst-affected tubers were only slightly injured for culinary purposes, yet their disfiguration would certainly have affected their salability. They showed no tendency to rot and the spots did not increase in size or depth.

It was decided to make an inquiry into the cause of the injury.

METHODS OF INVESTIGATION.

The season was so far advanced when the investigation was begun that it was impossible to do much experimental work in the spring of 1912. Three experiments were made during May and then the work was discontinued until January 30, 1913, when it was again taken up and pursued actively until May 26. Three additional experiments were made in the fall of 1913. The total number of fumigation experiments made was 89. The fumigation chamber was a wooden box of 21.56 cubic feet capacity. Its inside dimensions were 34.5 x 36 x 30 inches. It was constructed of well-seasoned matched lumber

and painted inside. On one side there was a hinged door 17 x 23 inches. In the first 30 experiments some leakage of gas occurred around the door. Then the fittings of the door were tightened so that in subsequent experiments (excepting No. 89) scarcely any odor of escaping gas could be detected. During 22 of the experiments (Nos. 31 to 37, 51 to 55 and 76 to 85) the box stood in the cement cellar where the original injury occurred; during 43 experiments (Nos. 1 to 30 and 38 to 50) it stood in the furnace room of a greenhouse; during 21 experiments (Nos. 56 to 73 and 87 to 89) it stood in an unheated barn where doors on opposite sides permitted a free circulation of the outside air; during Experiments 74 and 86 it stood in the open air; and in Experiment No. 75 under a shed open on one side. In the first eleven experiments the humidity is unknown and the temperature was not very accurately determined; but in experiments subsequent to No. 11, and excepting Nos. 87–89, both the humidity and the temperature were recorded by a Friez hygrothermograph [10] placed inside the box. The generator used was a pint tin cup with flaring sides. In the first four experiments the charge consisted of 14.06 grams of potassium permanganate and 30.6 cubic centimeters of formaldehyde solution. These quantities are equivalent to 23 ounces of permanganate and three pints of formaldehyde to 1000 cubic feet (Morse's formula), but as they were found somewhat difficult of exact measurement we used, instead, 14.25 grams $KMnO_4$ and 30 cubic centimeters CH_2O in subsequent experiments. It will be observed that the ratio of $KMnO_4$ to CH_2O is that recommended by Evans [11] and that the quantity of formaldehyde solution used was equal to 1391.4 cubic centimeters (a trifle less than three pints [12]) per 1000 cubic feet. In all but three of the experiments the time of exposure was 24 hours. The bulk of the potatoes were exposed in bushel crates, but in addition there was invariably a check of 10 to 40 test tubers spread upon the floor of the fumigation chamber. The test tubers were thoroughly washed in order that any injury to them might be readily detected. After treatment they were stored in a

[10] Kindly loaned by Dr. L. Knudson of the Department of Plant Physiology, New York State College of Agriculture.

[11] Evans, H. D. Disinfection by the formalin-permanganate method. Me. State Bd. of Health Rpt. 14:227–249. 1906.

[12] Three pints = 1419.45 cubic centimeters.

partially darkened room and kept under observation for at least two weeks. Unless otherwise stated all tubers were thoroughly dry at time of starting the experiment and of approximately the same temperature as the air of the room in which the experiment was made. The potassium permanganate was in the form of slender needle-shaped crystals. In all except the first three experiments the formaldehyde solution was taken from the same bulk. An analysis made by the Chemical Department of the Station showed that it contained 37.1 per ct. of formaldehyde.

SEVERAL FACTORS INVOLVED.

Since the treatment was made strictly in accordance with the directions given by Morse it was evident that the injury was due to some factor not recognized and, probably, not encountered by him in his long experience with the treatment. Hence, the first step in the investigation was to determine in what respects the conditions of our case were unusual. It was noted: (1) That the temperature was low (45 degrees Fahr.); (2) that the relative humidity was very high (probably near the dew point); (3) that the quantity of potatoes treated was small in proportion to the space (1.5 lbs. per cubic foot); and (4) that the severely injured tubers were of the variety Sir Walter Raleigh while two bushels of another variety, Rural New Yorker No. 2, were only slightly injured.

Ultimately, it was discovered that the unknown chief factor was *the small quantity of potatoes* while the high relative humidity and sprouted condition of the tubers were important accessories. Besides these three principal factors there are, also, some minor ones which require consideration. The several factors entering into the problem will be discussed in turn.

QUANTITY OF POTATOES.

In our original trial of the treatment (the one which brought about this investigation) the cellar contained about 1.5 lbs. of potatoes per cubic foot. As has already been stated, many of the tubers were severely injured. Our early experiments (Nos. 1–12) were all made with very small quantities of potatoes — less than one-half pound per cubic foot — and severe lenticel injury resulted in every case notwithstanding the temperature and humidity varied considerably in different experiments. It then occurred to us to try a much larger quantity. In Experiment No. 13 the fumigation

chamber contained 5.7 bushels or about 16 lbs. per cubic foot. When the door was opened, at the end of 24 hours, it was found that the formaldehyde gas had nearly all disappeared. Immediately after the door was opened one of the writers thrust his head into the box and held it there for over a minute without discomfort; whereas, in previous experiments the gas had been so strong as to be almost suffocating. The tubers were entirely free from injury. Three other experiments were made with 16 lbs. per cubic foot with the same result — the practical disappearance of the gas and no injury to the tubers. In other experiments varying quantities of potatoes were used in an attempt to determine the least quantity that could be treated with safety. Traces of lenticel injury occurred with all quantities up to 12 lbs. per cubic foot, but no eye injury appeared when five pounds or more per cubic foot were used. While the injury resulting from the treatment plainly bore an important relation to the quantity of potatoes per cubic foot, it did not decrease uniformly as the quantity of potatoes increased. In different experiments with the same quantity of potatoes varying degrees of injury resulted. The extent of this variation may be seen by an examination of Table I.

It having been determined that the exposure of a large quantity of potatoes caused the disappearance of the gas and prevented injury, the question arose as to the manner in which it is brought about. Does the gas enter into chemical combination with the substance of the potatoes or is it merely held on the surface of the tubers? When lesions appear there can be no doubt that some of the gas has combined with the contents of the cells and caused their death. It is known that formaldehyde may combine with protein bodies.[13] But when there are no lesions on the tubers the proof of chemical union is less evident. As regards the alternate proposition, chemists and physicists have long known that objects of many different kinds have the power of holding upon their surface considerable quantities of any gas surrounding them. This is known as

[13] Bliss, C. L., and Novy, F. G. Action of formaldehyde on enzymes and on certain proteids. *Jour. Exp. Med.* 4:47–80. 1899.

Steinegger, R. Die Einwirkung des Formaldehyds auf die Eiweisskörper. *Land. Jahr. Schweiz* 19:524–525. 1905.

Lepierre, C. Einwirkung des Formaldehyds auf die Eiweisskörper. Umwandlung der Peptone und Albuminosen in Primäre Eiweisstoffe. *Jour. Phar. Chim.* [6], 9:449–451. 1899. Abstract in *Ztschr. Untersuch. Nahr. u. Genussmtl.* 2:924. According to this author the action of formaldehyde on protein bodies consists in the condensation and withdrawal of water with the simultaneous occurrence of methyl groups in the protein molecule.

adsorption.[14] Several investigators of formaldehyde disinfection

[14] Patten and Waggaman (Absorption by soils. U. S. D. A. Bur. Soils Bul. No. 52. 1908) have given a résumé of the voluminous literature of absorption and adsorption, especially in its relation to soils. Their view of the nature of adsorption appears in the following statement (p. 11): "A special case of absorption has been termed *adsorption*, which may be defined as the existence of a difference in concentration or density of a film adjacent to a bounding solid and the concentration or density of the mass of the liquid or gas which bathes this solid. Whether this adsorbed film is in a liquid, solid, or gaseous state, or even loosely combined with the solid bounding medium, is not easily determined and has been the subject of much discussion. The change of state from solid to liquid and from liquid to vapor, is very gradual. All the recent physical researches, dealing even with hard, polished 'solid' surfaces, indicate a mobility of parts, an openness of structure, and a high power of retaining foreign material. But the ability of one body to hold another upon its surface is dependent upon the material of which each consists. So we are accustomed to say that adsorption depends upon the chemical constitution of the solid as well as of the substance adsorbed. Another way of stating the same idea is to attribute adsorption to a specific attraction between solid and adsorbed material."

The great adsorptive capacity of charcoal is well known and often utilized in various arts and industries. "Boxwood charcoal will in this way absorb ninety times its own volume of ammonia, fifty volumes of hydrogen sulphide, or nine volumes of oxygen. * * * The absorbed gases may be removed unchanged by heating the charcoal in a vacuum. The disappearance of these immense quantities of gas into small pieces of charcoal is described as *adsorption* and is caused by the adhesion of the gases to the very extensive internal surface which charcoal possesses. Solid and liquid bodies are also in many cases taken up by charcoal in a similar fashion. Thus, strychnine may be removed from an aqueous solution by agitation of the latter with charcoal. In the manufacture of whiskey, the fusel oil, which is extremely harmful is in many cases removed by filtration of the diluted spirit through charcoal, before rectification. Organic coloring matters, such as litmus and indigo, belong to the class of bodies thus extracted from solution by charcoal. In the refining of sugar the syrup is boiled with charcoal for the purpose of removing a brown resin, in order that the product may be perfectly white. It is, in part, upon this property that we rely, also, in the employment of charcoal filters. The organic materials dissolved in the drinking water undergo adsorption in the charcoal. In this connection, however, it must be remembered that the quantity which a given mass of charcoal may take up is limited, and that careful cleansing is required in order that the efficiency of the filter may be maintained." (Smith, Alexander. Introduction to general inorganic chemistry, p. 476, 1907.)

In discussing the relation of deleterious chemical agents to the growth of plants Duggar (Plant physiology with special reference to plant production, p. 440. 1911) says: "Solid particles such as pure sand, graphite, and filter paper, may reduce toxic action to a considerable extent. True and Oglevee [*Bot. Gaz.* 39:1–21. 1905] found that twice as much sand as solution may reduce the toxic action of Cu SO_4 for *Lupinus albus* as much as thirty-two times. The method of reducing toxicity by solid particles is usually denoted adsorption. It is a phenomenon explained upon the hypothesis that many molecules (or ions) of the toxic substance are physically held by the surfaces of the particles of the inert material, and are, for the time, removed from the possibility of chemical action. Another explanation is that the solid substances offer obstacles to the free movement of the solvent particles. Possibly both views are important. Many of the so-called absorptive properties of soils both respecting fertilizers and deleterious agents are in reality adsorptive." On this phase of adsorption see, also, Jensen, G. H. Toxic limits and stimulation effects of some salts and poisons on wheat. *Bot. Gaz.* 43:11–44. 1907.

have observed that the formaldehyde gas is adsorbed to a great extent by objects in the disinfection chamber. It has been pointed out by Peerenboom,[15] Rubner and Peerenboom,[16] v. Brunn,[17] Jörgensen,[18] Walter and Schlossman,[19] and Werner[20] that the area of the surface exposed by the walls and objects in the room may affect, materially, the efficiency of the disinfection. However, it appears that little or no account is taken of this in practical disinfection in America.[21] In the formaldehyde gas treatment of seed potatoes it has been entirely ignored.

In order to determine whether the disappearance of the gas in the experiments described above was due to adsorption the following three experiments were made: A quantity of cobblestones (5.5 bu. = 786.5 lbs. = 1485 stones) approximately the size and shape of potatoes, and hence having approximately the same surface area as potatoes, were washed and dried, then placed in the fumigation box and treated with formaldehyde gas in the same manner as a similar quantity of potatoes had been treated in Experiments 13 and 16. The stones occupied six crates. Thirty cubic centimeters of formaldehyde solution and 14.25 grams of potassium permanganate were used. The fumigation chamber was kept closed 24 hours. The test objects were 20 potatoes just commencing to sprout. In the first stone experiment (No. 38) the initial humidity was 75 per ct. and the maximum 81 per ct.; the initial temperature

[15] Peerenboom. Zur Verhalten des Formaldehyds im geschlossenen Raum und zu seiner Desinfektionswirkung. *Hyg. Rundschau* 8:776. 1898.

[16] Rubner u. Peerenboom. Beiträge zur Theorie und Praxis der Formaldelhyd-desinfektion. *Hyg. Rundschau* 9:266. 1899.

[17] v. Brunn, M. Formaldehyde desinfection durch Verdampfung verdünnten Formalins. *Ztschr. Hyg. u. Infectionskr.* 30:216, 230. 1899.

[18] Jörgensen, A. Untersuchung über Formaldehyddesinfection nach der Breslauer Methode, speciell Desinfection von Uniformen betreffend. *Ztschr. Hyg. u. Infectionskr.* 45:279. 1903. With bibliography of 72 numbers.

[19] Walter u. Schlossman. *München. Med. Wchnschr.* 1899. Cited by Jörgensen.

[20] Werner, G. Zur Kritik der Formaldehyddesinfektion. *Arch. Hyg.* 50:361. 1904.

[21] Health officers in this country now quite generally employ formaldehyde gas, generated by the permanganate method, for the disinfection of rooms in which cases of contagious disease have occurred. The directions given usually call for a certain amount of formaldehyde solution and potassium permanganate per 1000 cubic feet of space without regard to the contents of the room.

Although McClintic's investigation (Pub. Health and Mar. Hosp. Ser. U. S. Hyg. Lab. Bul. 27. 1906) was made "with special reference to car sanitation" no account was taken of the area of surface exposed. Probably, the disappearance of the gas which McClintic observed in his car experiments and which he ascribed to leakage (p. 78) was in large part due to adsorption.

56 degrees Fahr. and the maximum 62 degrees Fahr. When the box was opened it was found that most of the gas had disappeared though there was still left enough to cause the eyes and throat to smart when one's head was held in the box. Apparently, there was a little more gas than in Experiment No. 13. Not a trace of injury of any kind appeared on the test tubers.

Between Experiments 38 and 39 the door of the fumigation chamber was left open for 2½ hours, but the stones were not removed. In the second stone experiment (No. 39) the initial humidity was 68 per ct. and the maximum 90 per ct.; the initial temperature, 59 degrees, the maximum 62 degrees. There were 20 test tubers, 10 of which had barely started to sprout while the other 10 had sprouts one-fourth inch long. The quantity of gas present when the door was opened seemed to be about the same as in the previous experiment. The only indication of injury was a slight browning of the tips and bases of some of the larger sprouts.

Between Experiments 39 and 40 the door of the fumigation chamber was left open 67 minutes for airing, but the stones were not removed.[22] In the third stone experiment (No. 40) the 20 test tubers bore sprouts one-fourth to one-half inch long. The initial humidity was 63 per ct. and the maximum 88 per ct.; the initial temperature 58 degrees and the maximum 61 degrees. The gas present at the close of the experiment appeared about the same as in the previous two experiments. Several of the larger sprouts were browned a little at the base and a few were killed, but the eyes sprouted again and the germination appeared normal. There was no lenticel injury.

These experiments with stones show the importance of adsorption in formaldehyde disinfection. It appears that stones have practically the same effect as potatoes in taking up the gas and preventing injury. As chemical union between the formaldehyde and the stones is impossible it must be that the gas was adsorbed on the surface of the stones. Hence, we conclude that when potatoes take up formaldehyde gas it is chiefly by adsorption.

That partly filling the fumigation chamber with stones or potatoes should have the effect of preventing injury to the test tubers appears

[22] Even though the stones were aired somewhat between experiments their capacity for adsorption must have been considerably reduced by the previous treatments. However, it was not shown in the effects on the test tubers.

paradoxical. By measuring the water displaced by a bushel of the stones it was computed that the 5.5 bushels of stones occupied 4.84 cubic feet of space. Hence, the introduction of the stones into the fumigation chamber reduced the space occupied by the gas from 21.56 cubic feet to 16.72 cubic feet. In the same manner it was determined that a bushel (60 lbs.) of potatoes occupies 1544 cubic inches of space.[23] Accordingly, in Experiments 13, 16, 55 and 86 in which the fumigation chamber contained 16 lbs. of potatoes per cubic foot, or a total quantity of 5.7 bushels, the potatoes occupied 5.09 cubic feet or nearly one-fourth of the total space content of the chamber. Were it not for the factor of adsorption this would result in increasing the concentration of the gas. As a matter of fact, the concentration of the gas was greatly *decreased.*

In our experiments we have been able to bring about injury or avoid it at will simply by varying the quantity of potatoes per cubic foot of space. When the quantity is small injury invariably results; when it is large there is no injury. This holds under all the conditions of humidity, temperature and germination ordinarily encountered in the treatment of seed potatoes. Hence, we conclude that our disaster in the spring of 1912 was due primarily to the small quantity of potatoes per cubic foot of cellar space.

That serious injury from the gas treatment has not been reported previously is probably due to the fact that small quantities of potatoes are rarely treated in large chambers owing to the large expense for chemicals. Dr. Morse informs us that in his experiments[24] at Houlton, Me., the disinfection chamber contained somewhat more than ten pounds per cubic foot. However, at other times considerably smaller quantities were treated in the same room and yet no injury was reported to him. Judging from our own experience it seems as if considerable lenticel spotting, at least, must have occurred in the experiments made by Jones and Morse[25] in 1904 and 1905. In a tight box containing 8.2 cubic feet they treated 30 lbs.

[23] The average of three tests in which the results varied from 1539.35 to 1550.33 cubic inches. The specific gravity of the tubers varied from 1.0711 to 1.0787, the average being 1.0744. Woods and Bartlett (Me. Sta. Bul. 57 : 151) found the specific gravity of potatoes to vary from 1.0604 to 1.1129. Watson, who made numerous determinations on several different varieties grown in different parts of the United States (Va. Sta. Buls. 55 and 56) gives 1.035 as the lowest and 1.103 as the highest specific gravity found.

[24] Reported in Maine Sta. Bul. 149:305.

[25] Vt. Sta. Rpts. 17:397–401 and 18:287–291.

of potatoes for 24 hours with the gas from 25 cubic centimeters of formaldehyde solution. That is, the quantity of potatoes was 3.7 lbs. per cubic foot and the quantity of formaldehyde solution more than twice the standard quantity. It may be that their failure to observe any injurious effect of the treatment was due to the tubers being planted before the injury manifested itself. If unsprouted tubers were used there may have been only lenticel spotting, without eye injury, and the germination may not have been materially affected.

In an attempt to duplicate their experiments we made Experiments 87–89. (See Table II.) Calculated for our fumigator, containing 21.56 cubic feet, the equivalent quantities of formaldehyde and potassium permanganate would be 65.75 cubic centimeters of the former and 24.65 grams of the latter. These quantities were used. Experiments 87 and 88 were made in the latter part of September with freshly-dug tubers. The varieties Irish Cobbler and Green Mountain were used in Experiment 87 and Sir Walter Raleigh and Gold Coin in Experiment 88. Experiment 89 was made in November with the varieties Sir Walter Raleigh and Rural New Yorker No. 2. Considerable leakage of gas occurred on Experiment 89. In all three of these experiments there was severe lenticel spotting but no eye injury.

The conditions under which the Vermont experiments were made appear to have been comparable, also, to those in our Experiment 78 (See Table II) in which the tubers showed considerable lenticel spotting and much eye injury.

TABLE I.—EFFECT OF FORMALDEHYDE GAS ON POTATO TUBERS: STANDARD TREATMENT.*

Quantity of tubers.	Number of experiment.	Humidity. Initial.	Humidity. Maximum.	Humidity. Closing.	Temperature. Initial.	Temperature. Maximum.	Temperature. Minimum.	Condition of test tubers before treatment.	Injury. Lenticel spotting.	Injury. Eye injury.
Tubers.		Per ct.	Per ct.	Per ct.	Deg. F.	Deg. F.	Deg. F.			
12	1	.....	.....	.....	67	69	.....	Sprouted	Much	Much.
15	2	.....	.....	.....	59	60	.....	Sprouted	Much	Much.
34	3	.....	.....	.....	64	72	47	Sprouted	Much	Much.
20	4	.....	.....	.....	65	65	37	Unsprouted	Much	None.
29	5	.....	.....	.....	50	.....	.....	Unsprouted	Much	None.
25	6	.....	.....	.....	52	55	37	24 unsprouted	Considerable	None.
								1 slightly sprouted	Considerable	2 eyes ruined.
20	7	.....	.....	.....	48	52	36	Unsprouted	Much	None.
20	8	.....	.....	.....	51	55	40	Unsprouted	Much	None.
26	9	.....	.....	.....	44	50	35	Slightly sprouted	Much	Considerable.
20	10	49	.....	.....	55	61	55	Unsprouted	Much	None.
35	11	.....	.....	.....	56	61	43	Unsprouted	Much	None.
20	12	46	76	68	59	62	51	Unsprouted	Much	None.
20	14	66	86	71	63	66	55	Unsprouted	Much	None.
20	20	79	101	90	55	57	46	Slightly sprouted	Much	Much.
20	23	63	93	83	63	63	53	Slightly sprouted	Much	Much.
30	26	75	102	92	50	61	48	25 unsprouted	Much	None.
								5 sprouted	Considerable	Much.
20	28	59	80	68	58	65	53	10 unsprouted	Much	Trace.
								10 sprouted, .12 in.	Much	Much.
33	30	54	77	69	60	66	58	10 unsprouted	Much	None.
								10 barely started	Much	Much.
								13 sprouted, .12 in.	Much	Much.

* As recommended by Morse. In first three experiments 30.6 cubic centimeters formaldehyde solution and 14.06 grams potassium permanganate to 21.56 cubic feet; in all others, 30 cubic centimeters formaldehyde and 14.25 grams permanganate to 21.56 cubic feet (= 3 pints formaldehyde and 23 ounces permanganate to 1,000 cubic feet). Time of exposure, 24 hours.

20	31	83	87	75	41	43	40	{ 10 unsprouted	Considerable	None.
								10 sprouted, .12 in.	Considerable	Much.
20	32	85	89	83	37	39	37	Sprouted, .12 to .25 in.	Considerable	Much.
20	33	91	93	89	36	39	36	{ 10 unsprouted	Much	None.
								10 sprouted, .12 to .25 in.	Considerable	Considerable.
20	35	90	92	90	42	45	42	{ 10 unsprouted	Much	A little.
								10 sprouted, .12 to .25 in.	Much	Much.
20	36	90	92	90	43	46	41	{ 10 unsprouted	Much	A little.
								10 sprouted, .12 to .25 in.	Much	Much.
20	37	88	89	85	41	43	40	{ 10 unsprouted	Much	A little.
								10 sprouted, .5 in.	Much	Much.
40	44	71	101	94	58	65	54	{ 20 sprouted, .25 in.; dry	Much	Much.
								20 sprouted, .25 in.; wet	Much	Much.
36	59	45	.....	77	50	†58	.....	10 varieties, barely started	Considerable	A little.
36	65	48	88	79	63	66	57	10 varieties, sprouted, .25 in.	Much	Considerable.
23	72	71	96	83	53	61	53	{ 11 barely started	Much	Much.
								12 sprouted, .5 in.	Considerable	A little.
33	73	50	89	82	68	71	60	Sprouted	Much	Much.
*Lbs.**										
1.5	34	94	97	96	41	43	41	Unsprouted	Much	None.
1.5	50	64	85	78	55	63	55	{ Part unsprouted	Considerable	None.
								Part sprouted, .12 in.	A little	Considerable.
1.5	67	46	78	78	69	69	58	Sprouted, .25 in.	A little	Trace.
1.5	76	79	91	86	54	56	53	Sprouted, .06 to .12 in.	Considerable	Much.
1.5	80	66	82	70	50	51	49	{ Sprouted, .12 to .25 in.	Considerable	Much.
								Sprouted, .75 in.	A little	None.
1.5	85	69	91	77	54	54	51	Sprouted, .25 in.	Considerable	Much.
2	45	53	84	85	53	57	49	Unsprouted	Considerable	None.
2	48	71	86	83	69	70	60	{ Part barely started	Much	None.
								Part sprouted, .25 in.	Much	Considerable.
2	52	85	85	73	40	42	40	{ Part barely started	A little	None.
								Part sprouted, .12 in.	A little	Trace.
2	56	70	92	86	43	46	43	{ Part barely started	Trace	None.
								Part sprouted, .12 in.	Trace.	Trace.
2	79	62	81	74	49	50	48	Sprouted, .12 to .25 in.	Considerable	Much.

* Number of pounds per cubic foot of space in fumigation chamber.

† Closing temperature. The temperature and humidity pointers became entangled soon after the experiment started and did not free themselves until near the close. Hence, only the initial and closing temperature and humidity are known.

TABLE I — *continued*

Quantity of tubers.	Number of experiment.	Humidity. Initial.	Humidity. Maximum.	Humidity. Closing.	Temperature. Initial.	Temperature. Maximum.	Temperature. Minimum.	Condition of test tubers before treatment.	Injury. Lenticel spotting.	Injury. Eye injury.
*Lbs.**		*Per ct.*	*Per ct.*	*Per ct.*	*Deg. F.*	*Deg. F.*	*Deg. F.*			
2	83	89	94	90	50	51	49	Sprouted, .25 in.	Considerable.	Much.
3	43	54	84	78	54	60	54	Barely started	Trace	None.
3	46	55	80	80	55	62	55	Part barely started	Considerable.	None.
								Part sprouted, .25 in.	A little	Trace.
								Part sprouted, .75 in.	Trace	Trace.
3	51	60	77	77	45	46	40	Part barely sprouted	Trace	None.
								Part sprouted, .12 to .25 in.	Trace	Trace.
3	57	77	89	85	46	50	46	Part barely sprouted	Trace	None.
								Part sprouted, .12 to .25 in.	Trace	None.
3	61	58	89	87	48	48	37	Sprouted, .12 to .25 in.	None	None.
3	63	58	80	78	47	55	47	Sprouted, .5 in.	Trace	None.
3	64	64	86	83	65	65	55	Sprouted, .5 to .75 in.	Trace	A little.
3	66	51	80	78	69	69	61	Sprouted, .75 to 1 in.	A little	None.
4	77	80	89	83	53	55	52	Sprouted, .06 to .12 in.	Considerable.	Considerable.
4	42	61	87	76	54	58	53	Barely started	Considerable.	None.
4	47	66	77	76	62	68	62	Barely started	A little	None.
4	58	62	91	91	49	50	45	Part barely started	None	None.
								Part sprouted, .25 in.	None	None.
4	70	59	88	88	47	51	47	Part barely started	A little	None.
								Part sprouted, .5 to .75 in.	None	None.
4	84	90	96	91	50	52	50	Sprouted, .25 in.	Considerable.	Much.
5	41	60	90	89	54	57	54	Barely started	A little	None.
5	49	51	82	82	58	58	54	Part barely started	A little	None.
								Part sprouted, .12 in.	A little	None.
6	29	40	74	73	64	67	57	Unsprouted	A little	None.

* Number of pounds per cubic foot of space in fumigation chamber.

8	27	62	73	73	53	55	52	Unsprouted	Trace........	None.
8	53	83	87	81	40	42	40	Part barely started .... Part sprouted, .12 in........	Trace........	None.
8	60	49	94	94	59	59	49	Sprouted, .12 to .25 in......	None........	None.
8	74	47	94	94	78	87	70	Barely started.............	Trace........	None.
10	25	75	92	92	46	48	44	Unsprouted...............	Trace........	None.
12	22	80	90	89	51	54	51	Unsprouted...............	Trace........	None.
12	54	88	93	93	42	42	42	Part barely started......... Part sprouted, .12 in........	None........ None........	None. None.
12	62	44	79	79	41	44	41	Sprouted, .5 in............	None........	None.
12	75	67	96	96	65	65	53	Sprouted, .12 in............	None........	None.
14	19	89	98	96	52	53	50	Unsprouted...............	None........	None.
16	13	65	78	78	46	53	46	Unsprouted...............	None........	None.
16	16	51	79	79	51	52	49	Unsprouted...............	None........	None.
16	55	93	94	93	43	43	43	Part barely started......... Part sprouted, .12 in........	None........ None........	None. None.
16	86	51	104	104	59	59	53	Sprouted, .25 to .5 in.......	None........	None.

TABLE II.— EFFECT OF FORMALDEHYDE GAS ON POTATO TUBERS: MISCELLANEOUS EXPERIMENTS.*

Quantity of tubers.	Number of experiment.	Humidity.			Temperature.			Condition of test tubers before treatment.	Injury.	
		Initial.	Maximum.	Closing.	Initial.	Maximum.	Minimum.		Lenticel spotting.	Eye injury.
Tubers		*Per ct.*	*Per ct.*	*Per ct.*	*Deg. F.*	*Deg. F.*	*Deg. F.*			
20	17	51	76	64	48	55	55	Unsprouted	Considerable	None.
20	18	70	98	89	55	57	54	Unsprouted	Much	Much.
20	21	70	90	80	51	56	51	Slightly sprouted	Considerable	Considerable.
20	24	59	99	.....	50	53	40	Slightly sprouted	Much	Much.
23	68	88	95	95	51	52	51	10 barely started 13 sprouted, .25 in	Considerable Trace	Considerable. None.
23	69	95	100	100	52	54	52	10 barely started 13 sprouted, .25 in	Considerable Trace	A little. None.
23	71	52	93	93	48	50	48	10 barely started 13 sprouted, .5 in	Considerable Trace	Trace. None.
23	81	78	97	92	51	55	50	Sprouted, .25 in	Considerable	Much.
23	82	77	96	95	50	54	49	Sprouted, .25 in	Much	Much.
Lbs.										
4	78	75	93	89	52	54	50	Sprouted, .12 in	Considerable	Much.
3.7	87	.....	.....	.....	57	.....	.....	Unsprouted	Considerable	None.
3.7	88	.....	.....	.....	59	.....	.....	Unsprouted	Much	None.
3.7	89	.....	.....	.....	46	.....	.....	Unsprouted	Considerable	None.

* Experiments 17 and 21 were made with half the standard quantity of chemicals, viz., 15 cubic centimeters of formaldehyde and 7.15 grams permanganate to 21.56 cubic feet. Time of exposure, 24 hours. Experiments 18, 24 and 78 were made with double the standard quantity of chemicals, viz., 60 cubic centimeters formaldehyde and 28.50 grams permanganate to 21.56 cubic feet. Time of exposure, 24 hours. Experiments 81 and 82 were made with Lister's Fumigator. Time of exposure, 24 hours. Experiments 68, 69 and 71 were made with the standard quantity of chemicals, but the time of exposure was reduced to 3 hours. In experiments 87, 88 and 89 an attempt was made to duplicate the experiments of Jones and Morse (Vt. Sta. Rpt. 18:288). 65.75 cubic centimeters formaldehyde and 24.65 grams potassium permanganate were used in 21.56 cubic feet of space. Time of exposure 24 hours.

HUMIDITY.

All who have had much to do with formaldehyde disinfection recognize the importance of moisture. Numerous investigations have shown that in order to insure efficient disinfection it is necessary to have a comparatively high humidity. In the disinfection of living rooms during cold weather this factor is a very important one because in artificially heated rooms the relative humidity is usually low and special methods must be employed to raise it. A relative humidity of about 60 per ct. is usually considered the minimum for thorough disinfection. According to Dudley and McDonnell it is the *relative* humidity rather than the absolute humidity which is important.[26]

In the disinfection of seed potatoes the humidity factor has been taken into account by Morse[27] who recommends that "just before placing the formaldehyde in the generator the floor of the disinfecting chamber should be thoroughly wet down with boiling water."

Our own studies have dealt with the causes of tuber injury rather than with the efficiency of disinfection, but it seems reasonable to assume that anything which tends to increase the efficiency of disinfection would tend to increase injury to the tubers. If so, raising the relative humidity in the disinfection chamber might be expected to increase the liability of the tubers to injury. As a matter of fact, our experiments seem to show that such is the case, but the evidence is not entirely conclusive. As no means were employed for accurately controlling either the temperature or the humidity, and the factors of quantity and germination were also variable, the experiments were so much complicated that close comparisons are impossible. By an examination of Tables I and II it will be seen that the relative humidity was rather high in all of the experiments. The lowest maximum humidity was 73 per ct. in Experiment 27. In the majority of the experiments the maximum was in the neighborhood of 90 per ct. This may account for the failure of the experiments to show marked effects from changes in humidity.

When small quantities of potatoes are treated the maximum humidity is usually reached in from two to four hours after starting the

[26] Dudley, C. B., and McDonnell, M. E. Disinfection of passenger cars. Reprint from the *American Engineer and Railroad Journal*, June, 1902.

[27] Me. Sta. Bul. 174:325.

generator, and then there follows a marked decline. When the initial humidity is below 80 per ct. there is usually a sudden rise of 15 to 25 per ct. owing to the water vapor produced by the evaporation of the formaldehyde solution. McClintic [28] has expressed the opinion (based on the results of some of his experiments) that the moisture given off by the evaporation of the formaldehyde solution does not answer for disinfection purposes so well as the natural humidity in the atmosphere. The writers have observed nothing which indicates that this is true for tuber injury nor does there seem to be any reason why it should be so. Both chemically and physically the water vapor produced by the evaporation of formaldehyde solution is the same as that in the air.

When large quantities of potatoes are treated the maximum humidity is not usually attained until at or near the end of the 24-hour period. This is probably due to the influence of the moisture produced by the respiration of the tubers.

While the general trend of the relative humidity is as stated above there are frequent exceptions. Changes in temperature, of course, affect the relative humidity considerably and as the disinfection chamber was not perfectly gas-tight changes in the humidity of the outside air, also, had some influence.

Although convinced that a comparatively high relative humidity is necessary for the successful disinfection of seed potatoes by means of formaldehyde gas the writers consider it unnecessary to wet the floor with boiling water as recommended by Morse or to employ any other means to increase the humidity. In cellars and store rooms suitable for seed potatoes the humidity is naturally high, particularly in the spring when the treatment is made. In addition to the natural humidity the evaporation of the formaldehyde solution may be expected to supply from 15 to 25 per ct. and the respiration of the tubers, also, furnishes a considerable amount of moisture. As a matter of course, an artificially heated room would not be used for a disinfection room and in almost any unheated room the humidity may be expected to be ample for the purpose of disinfection.

Experiments made by Jones and Morse[29] indicate that the gas

[28] McClintic, T. B. The limitations of formaldehyde gas as a disinfectant. Pub. Health and Mar. Hosp. Ser. U. S. Hyg. Lab. Bul. 27:110. 1906.
[29] Vt. Sta. Rpt. 17:401.

treatment is more effective upon dry potatoes than upon wet ones. From our own experiments it appears that wetting the tubers increases rather than diminishes the liability of the tubers to injury. In Experiments 1, 2, 3 and 44 some of the test tubers were dry and others wet. In Experiment 44 both lots of tubers were severely injured (completely ruined) without any appreciable difference between the wet and the dry ones; but in the other three experiments the wet tubers showed decidedly more injury than the dry ones. It is also worthy of note that of the six experiments in which the quantity of potatoes was 4 lbs. per cubic foot the greatest amount of injury occurred in No. 84 the only one in which the test tubers were wet. However, the humidity was somewhat higher in this experiment than in any of the others.

In the practical disinfection of seed potatoes the wetting of the tubers is liable to be encountered, sometimes, in an unexpected and annoying manner. Objects transferred from a cool room into warm moist air quickly condense moisture upon their surface and become quite wet. This happens to potatoes when removed from a cool cellar to the warmer air of the disinfection room.

TEMPERATURE.

Although it is stated by Dudley and McDonnell[30] "that we are fairly safe in ignoring temperature in the matter of disinfection with formaldehyde down to as low, at least, as 32 degrees Fahr." it is generally held that a moderately high temperature (60 degrees Fahr. or more) is essential to thorough disinfection.[31] At lower temperatures a portion of the formaldehyde becomes polymerized, that is, changed into an amorphous white substance called paraformaldehyde which is believed to be useless for purposes of disinfection. McClintic[32] says: "The effects of temperature seem to be principally upon the state of the formaldehyde after it is liberated; that is, below a certain point it polymerizes." In one of his experiments in sleeping cars "at a temperature of 46 degrees Fahr. polymerization was so marked that the deposit of paraform gave the interior furnishings of the car a frosty appearance."[33]

[30] *Loc. cit.*, page 8.

[31] A review of the early literature of this subject is given by Mayer and Wolpert. Zur Rolle der Lufttemperature bei der Formaldehyddesinfektion. *Hyg. Rundschau* 11 : 396–400. 1901.

[32] *Loc. cit.*, page 110.

[33] *Loc. cit.*, page 91.

The following statement by Base[34] appears in his report on the chemical work done in connection with McClintic's investigation: "M. B. Porch (Assistant in Pharmacology, Hygienic Laboratory, Washington), using the same apparatus and methods that I did, but working at lower temperatures, found that polymerization of formaldehyde gas begins at about 62 degrees Fahr., and becomes more marked as the temperature decreases, which is evidenced by the persistent hazy condition of the air of the room, the low percentage yield of formaldehyde, and the deposition of paraformaldehyde in the room. He obtained in the permanganate-formalin method a yield of 25.1 per ct. at 62 degrees Fahr. and 11.1 per ct. at 52 degrees Fahr., as against 38.39 per ct. obtained by me at the higher temperatures of my experiments, namely, 71 degrees and 79 degrees Fahr."

According to Rosenau[35] "the action of the gas seems to be about the same between the temperatures of 10 degrees C. and 27 degrees C. Higher degrees of heat materially aid the disinfecting power of the gas."

Discussing the disinfection of seed potatoes Morse says:[36] "Temperature is an important factor in disinfecting with formaldehyde. It is more effective above 80 degrees Fahr. and disinfection with this gas should never be attempted where the temperature of the chamber used is below 50 degrees Fahr."

In 21 of our experiments the temperature was at or below 50 degrees Fahr. and in two of them below 40 degrees Fahr.; yet more or less injury occurred in 16 of these experiments, being quite severe in some of them. Even in Experiment 32, in which the maximum temperature was 39 degrees Fahr., fully one-half the eyes on the tubers were ruined. Most of the experiments were conducted at temperatures of 50 to 70 degrees Fahr.; temperatures higher than 70 degrees were had in only two experiments, viz. No. 3 in which the maximum temperature was 72 degrees and in No. 74 in which it was 87 degrees Fahr. We were able to obtain the high temperature of 87 degrees only by placing the disinfection chamber

[34] Base, Daniel. Formaldehyde disinfection. Determination of the yield of formaldehyde in various methods of liberating the gas for the disinfection of rooms. *Jour. Am. Chem. Soc.* 28 : 989. 1906.

[35] Rosenau, M. J. Disinfection and disinfectants, p. 90. P. Blakiston's Son & Co. Philadelphia. 1902.

[36] Me. Sta. Bul. 174 : 325.

out of doors in the sun on a hot day. In practice, temperatures above 70 degrees Fahr. will be encountered but rarely in New York. The heat generated by the chemical reaction commonly raised the temperature of the disinfection chamber only one or two degrees.

As regards the influence of temperature, the most instructive experiments are those in which the quantity of potatoes treated equalled 8 lbs. per cubic foot. With this quantity the injury is slight and if temperature is a factor of much importance it should be shown here; but we see no evidence of it. Comparing Experiment No. 53 in which the maximum temperature was 42 degrees Fahr. with Experiment No. 74 in which the maximum temperature was 87 degrees Fahr. we find that the injury was practically the same in the two experiments notwithstanding the relative humidity was somewhat higher in the latter than in the former. It should be borne in mind, also, that the temperature of the cellar in which the original case of injury occurred was only 45 degrees Fahr.

In several of the experiments in which the temperature ranged between 40 and 50 degrees pieces of smooth black paper were exposed inside the disinfection chamber. The amount of paraformaldehyde precipitated was sufficient merely to give a faint white-dusty appearance to the paper. In most cases it could be detected only by holding the paper so that the line of vision was nearly parallel with its surface. As no quantitative determinations were made it cannot be stated accurately to what extent such precipitation reduced the quantity of available gas, but some reduction certainly occurred. However, it may be that the loss in gas was offset by the increased adsorption at the lower temperature. It is known that adsorption varies considerably with the temperature. Whatever the explanation, the fact remains that severe injury occurred at temperatures between 40 and 50 degrees Fahr. So far as can be determined from our experiments there is no definite relation, within the limits of temperature likely to be used, between the temperature of the disinfection chamber and tuber injury.

What has been said above on the subject of temperature relates entirely to the temperature of the air in the disinfection chamber. There remains yet to be considered the temperature of the chemicals. In most of our experiments the temperature of the formaldehyde solution at the time of pouring it upon the potassium permanganate crystals was between 60 and 70 degrees Fahr. Probably, the tem-

perature of the potassium permanganate was, in most cases, a little above the initial temperature of the disinfection chamber. Only in two experiments (Nos. 1 and 15) were there any indications that the reaction had not been complete, and in these cases the low temperature of the formaldehyde solution was probably responsible.

For the purpose of securing information on this point the following experiments were made:

Experiment No. 1. In a large room in which the temperature of the air was 35 degrees Fahr. two generators were started simultaneously. In one of the generators the temperature of the chemicals at time of mixing was 51 degrees Fahr., in the other, 70 degrees Fahr. In each case 30 cubic centimeters of formaldehyde solution were poured upon 14.25 grams of needle-shaped crystals of potassium permanganate. Although the reaction began earlier and was finished earlier with the warm chemicals the end results appear to have been practically the same, except, possibly, the residue from the warm chemicals was a trifle drier than that from the cool chemicals. For practical purposes both reactions were satisfactory.

Experiment No. 2. Thirty cubic centimeters of formaldehyde solution and 14.25 grams of potassium permanganate crystals were exposed in the open air until they had acquired its temperature, viz., 34 degrees Fahr. They were then mixed in a pint tin cup having the same temperature. The mixture effervesced very feebly, barely ruffling the surface, and the reaction was a complete failure.

From these experiments it appears that the success of the reaction depends upon the temperature of the chemicals rather than upon the temperature of the air in the disinfection chamber. Whatever the temperature of the room, good results may be expected whenever the temperature of the chemicals at time of mixing is above 60 degrees Fahr.

SPROUTING.

In our first three experiments conducted with sprouted tubers during May, 1912, there was much eye injury as well as lenticel spotting exactly as had occurred in the original case of injury. When we began experimenting again in February, 1913, using unsprouted tubers, there was much lenticel spotting but no eye injury. (See Experiments 4, 5, 6, 7, 8, 10, 11, 12 and 13.) By using sprouted and unsprouted tubers in the same experiment it was shown that

Plate I.—Potato Tubers Injured by Fumigation with Formaldehyde Gas.
(Natural size)

PLATE II.— POTATO TUBER INJURED BY FUMIGATION WITH FORMALDEHYDE GAS: SHOWING LESSER SUSCEPTIBILITY OF THE "SEED" END. See Page 209.

sprouted tubers are much more susceptible to eye injury than are unsprouted ones. Many such experiments were made and the results were consistent throughout. (See Table I.) The slightest sprouting makes the tubers liable to eye injury. In fact, tubers with sprouts one-eighth of an inch long are more liable to eye injury than tubers with sprouts one-fourth to one-half inch long. Usually, it can be determined within two or three days after treatment whether the eyes have been injured. As a rule, injured eyes are surrounded by a ring of sunken, dead, brown tissue, but there are exceptions in which the eyes have been killed by the treatment yet show no injury to the surrounding skin.

Exposure to light makes the tubers more resistant to lenticel spotting. In numerous cases it was observed that tubers kept in a dimly lighted room for two or three weeks prior to treatment showed less lenticel spotting than tubers kept in a dark cellar. It was observed, also, that lenticel spotting is least severe (i. e., the spots are least numerous) at the bud or seed end of the tuber. Dumb-bell shaped tubers often show this in a striking manner. The tuber shown in Plate II was treated in Experiment No. 5. It bore 85 well-marked spots on the stem-end portion while on the seed-end portion there were only 20 spots and these were mostly small ones.

The probable explanation of this is that there are fewer lenticels on the seed end.

RELATIVE SUSCEPTIBILITY OF DIFFERENT VARIETIES.

Two crates of potatoes of the variety Rural New Yorker No. 2 which were in the cellar when the original treatment was made showed only traces of injury while the Sir Walter Raleigh potatoes were much injured. The only way in which we could account for this difference was that the variety Sir Walter Raleigh is more susceptible to such injury.

In order to secure some data on the relative susceptibility of different varieties the following experiments were made: In Experiments 9 and 11 potatoes from six different groceries were compared with our own Sir Walter Raleigh. It is not known to what variety any of the grocery potatoes belonged, but they were probably of different varieties. The severity and character of the injury varied somewhat with different lots, but the differences were small. In

Experiment No. 26 potatoes from five other groceries were compared with our Sir Walter Raleigh. The results were the same as in Experiments 9 and 11.

In Experiments 59, 65 and 73 ten varieties (three early and seven late) were compared with our own Sir Walter Raleigh. In the last of these the results were as follows: On five varieties (Twentieth Century, Rural New Yorker No. 2, Gold Coin, Sir Walter Raleigh from Honeoye Falls and Sir Walter Raleigh from Geneva) lenticel spotting was severe; on the other six varieties (Carman No. 3, Green Mountain, Ionia, Northern Beauty, Early Rose and Irish Cobbler) there was less, but considerable, lenticel spotting, Irish Cobbler showing the least. Eye injury was severe on all lots without any appreciable difference. In Experiment 88 lenticel spotting was considerably more severe on Gold Coin than on Sir Walter Raleigh and in Experiment 89 Rural New Yorker No. 2 was injured considerably more than Sir Walter Raleigh. The conclusion reached is that varieties may vary somewhat in their susceptibility to injury, but Sir Walter Raleigh is not more susceptible than some other common varieties.

SOME OTHER POSSIBLE FACTORS.

In the original case of injury it was observed that tubers exposed on the tops of the crates were severely injured while those on the interior of the crates were but slightly injured, if at all. Even tubers on the sides of the crates opposite the openings between the slats were much less injured than those on the top. This led to the suspicion that some substance precipitated from the air was chiefly responsible for the injury. In Experiment 1 three tubers were placed under an inverted glass dish in such manner that nothing could fall upon them from above. As these tubers were quite as much injured as unprotected tubers further experiments were not made. Whatever the explanation of the greater injury to tubers on the tops of the crates the phenomenon is worthy of note because it shows that tubers on the interior of the crates are much less liable to injury than those on the top. Presumably, there is a corresponding difference in the efficiency of the treatment. It is plain that uniform results will be obtained only when the tubers are exposed in very thin layers.

Another possible factor is the position of the tubers in the disinfection room. In most of our experiments the test tubers lay on the floor of the disinfection chamber. Also, in the original case of injury the crates of potatoes were all near the floor. Are tubers on the floor more, or less, liable to injury than tubers near the ceiling? According to Mayer and Wolpert[37] the concentration of the formaldehyde gas decreases from the ceiling downward and more thorough disinfection occurs at the ceiling than at the floor. In the single experiment (No. 23) conducted by us tubers on the floor were quite as severely injured as those near the ceiling.

Morse's caution to avoid placing tubers directly above the generator appears to be well founded. In one of our Experiments (No. 1) two tubers suspended in a wire basket 6½ in. above the generator were much more severely injured than tubers on the floor of the disinfection chamber. However, this can not have been a factor in the cellar experiment because none of the potatoes were above a generator or nearer than 2.5 feet to one. Provided the tubers are not over the generator it does not matter how near they are to it. In our experiments the generator was a pint tin cup. It was observed repeatedly that tubers lying on the floor within one inch of the generator were no more injured than those in the farthest corner of the chamber.

Any break in the skin of the tuber increases the liability to gas injury at that point. When pins are stuck into the tubers before treatment a sunken area of dead brown tissue appears around each pin. However, we believe Wollenweber to be in error when he says that the effect of formaldehyde is a test as to whether or not the skin is wounded.[38] If that be true there is no such thing as an unwounded potato because any potato treated with formaldehyde gas in the manner we have described will show the sunken, dead, brown spots.

That the gas enters by way of the lenticels is very plain in some cases and obscure in others. On potatoes grown in wet heavy soil the lenticels become abnormally developed. When the tubers are first dug such lenticels are plainly visible to the unaided eye as small white specks and they are readily detected even after the

[37] Mayer, E., und Wolpert, H. Beiträge zur Wohnungs-desinfektion durch Formaldehyd. *Hyg. Rundschau* 11:157. 1901.

[38] Wollenweber, H. W. Studies on the Fusarium problem. *Phytopathology* 3:43. 1913.

tubers have been long in storage. It occurred to us that such development of the lenticels might make the tubers more liable to gas injury, but we could find no evidence that such is the case.

It has been established that the quantity of formaldehyde gas evolved varies somewhat according to the proportions in which the chemicals are mixed. Several investigators have attempted to determine the most economical ratio of permanganate to formaldehyde, but if we are to judge by the recommendations of state boards of health in the United States they have not succeeded in fully solving the problem. Several different formulas are in use. But this is not a factor in our present problem because the proportions used at the time of our disastrous experience with the gas treatment, also in nearly all of our experiments, were those used by Morse in his experiments, viz., .475 gram of permanganate to each cubic centimeter of formaldehyde solution, which is the ratio recommended by Evans.[39]

Since our experiments have shown that the quantity of potatoes per cubic foot is a factor of prime importance the question naturally arises as to the advisability of varying the quantity of formaldehyde according to the quantity of potatoes. Undoubtedly, this must be done if uniform results are to be obtained, but the few experiments which we have made do not warrant us in making recommendations as to just how it should be done. In three of our experiments (Nos. 18, 24 and 78) the standard quantity of formaldehyde was doubled and in two others (Nos. 17 and 21) it was halved. (See Table II.) The tuber injury in Experiment No. 78, in which four pounds per cubic foot were treated with double the standard dose, was practically the same as in Experiments 79 and 83 in which half this quantity (2 lbs. per cubic foot) were treated with the standard dose.

In room disinfection 3 or 4 hours' exposure is usually deemed sufficient. In three of our experiments (Nos. 68, 69 and 71, Table II) the length of exposure was only three hours. The amount of tuber injury was appreciably less than in comparable experiments in which the exposure was 24 hours.

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[39] *Loc. cit.*

SIMILAR INJURY PRODUCED BY OTHER GASES AND LIQUIDS.

Tubers exposed to the fumes of ammonia, bromine or ether show depressed brown spots almost exactly like those resulting from fumigation with formaldehyde gas. According to Orton and Field a similar spotting may be produced by fumigation with sulphur.[40] In our experiments, dipping or soaking the tubers in strong solutions of formaldehyde and corrosive sublimate has had the same effect. In mild cases of injury only lenticel spotting occurred, while in more severe ones there was also eye injury as with tubers injured by treatment with formaldehyde gas. With the strengths commonly used in treating potatoes for scab, viz., one pint of 40 per ct. formaldehyde to 30 gals. of water (1 to 240) and one ounce of corrosive sublimate to 7 gals. water (1 to 1000, approximately), no spotting of any kind has been observed by us or by any one else so far as can be determined from the literature of the subject. Tubers dipped in 37 per ct. formaldehyde and those which were soaked two hours in 18 per ct. and 9 per ct. solutions showed both lenticel spotting and eye injury. Solutions of from 2 to 9 per ct. strength usually produced only lenticel spotting, although in one case some eye injury resulted from the use of a 1½ per ct. solution on sprouted tubers. When the dilution was below one per ct. no spotting occurred.

With corrosive sublimate some lenticel spotting occurred when tubers were soaked one and one-half hours in solutions as weak as 1 to 200.[41] In saturated solutions (1 to 16) and a 1 to 25 solution there was both lenticel spotting and eye injury.

FORMALDEHYDE GAS CAUSES SPOTTING AND BROWNING OF APPLES.

Some apples which were in the cellar at the time the original case of injury occurred showed severe lenticel spotting — circular, brown spots, 1 to 3 millimeters in diameter, surrounding the lenticels. Similar spotting, also a browning of the skin, occurred subsequently in several of our potato fumigation experiments in which a few apples were introduced into the fumigation chamber. On Rome

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[40] Orton, W. A., and Field, Ethel C. Sulphur injury to potato tubers. *Science* 31:796. 20 My 1910.

[41] One gram of corrosive sublimate dissolved in 200 cubic centimeters of distilled water.

apples the injury usually appeared in the form of lenticel spotting while on Baldwin it more frequently resembled "scald," a trouble of stored apples in which the skin becomes brown over large irregular areas with indistinct boundaries.

That formaldehyde, also ammonia, may cause lenticel spotting of apples has been announced previously by Norton[42] who points out that on the variety Jonathan the injury closely resembles the Jonathan fruit spot disease described by Scott.[43]

EFFECT ON GERMINATION AND GROWTH.

Throughout this bulletin lenticel spotting is referred to as injury and when no lenticel spotting occurred it has been stated that there was no injury. The question naturally arises, are tubers which show only lenticel spotting really injured for seed purposes? It may also be asked if tubers which show no lenticel spotting are certainly unharmed for use as seed. Our experiments have not been carried far enough to enable us to answer these questions fully. The sprouting of the tubers has been observed in all of the experiments and in a few of the experiments the tubers were planted in the greenhouse and kept under observation until the plants were about six inches high, but none were followed through to maturity. Judging from the observations made we are of the opinion that there may be considerable lenticel spotting without material injury to the tubers for seed. No matter how severe the lenticel spotting, sprouting usually appears to proceed normally provided there are no areas of dead brown tissue surrounding the eyes. However, exceptions to this have been seen occasionally. Treated tubers which are free from lenticel spotting may be regarded as safe for planting.

IS FORMALDEHYDE SOLUTION WEAKENED BY REPEATED USE?

The discovery that potatoes exposed to formaldehyde gas adsorb or hold upon their surface large quantities of the gas caused the writers to inquire if in the liquid treatment of potatoes for scab the formaldehyde solution might not be materially weakened by repeated use through the removal of formaldehyde adsorbed by the

[42] Norton, J. B. S. Jonathan fruit spot. *Phytopath.* 3:99–100. Ap. 1913.
[43] Scott, W. M. A new fruit spot of apple. *Phytopath.* 1:32–34. F. 1913.

tubers. Accordingly, the following experiment was made: Eighty cubic centimeters of 37 per ct. formaldehyde solution were mixed with 1600 cubic centimeters of distilled water thereby making a 1-to-21 solution. Ten successive lots of unsprouted tubers were each soaked two hours in this solution. Each lot contained as many tubers as the solution would cover, i. e., the solution was used to its full capacity each time. The total number of tubers treated was 165 and their total weight 41¾ lbs. The tubers were thoroughly washed before treatment. With different lots the temperature of the solution varied from 17 to 22 degrees C. After treatment the tubers were dried and then stored in a dimly-lighted room. The tubers of all ten lots showed slight lenticel spotting, Lot No. 10 being quite as much affected as Lot No. 1. Lots No. 1 and 10 were kept under observation for 16 days. Both lots sprouted vigorously and, apparently, in a normal manner. So far as could be determined from the effect on the tubers the strength of the formaldehyde solution had not been weakened. This conclusion is confirmed by the results of chemical analyses made by the Chemical Department of the Station. The solution which had been used ten times was found to contain 2.01 per ct. formaldehyde while a portion of the solution which had not been used contained 2.02 per ct. formaldehyde.

HOW SHOULD THE FORMALDEHYDE GAS TREATMENT BE MADE?

In the light of this investigation how should the formaldehyde gas treatment be applied? First of all, it may be said that the gas treatment should be used only in cases in which it is impracticable to use either of the liquid treatments. The safety and efficiency (for scab) of the liquid treatments have been thoroughly established. With our present knowledge, the gas treatment as recommended by Morse may be applied with entire safety provided *the fumigation chamber contains at least ten pounds of potatoes per cubic foot of space;* but it is uncertain what effect this will have on the efficiency of the treatment. That it is possible to secure efficiency without injury to the tubers is indicated by Morse's experiment at Houlton, Maine, although as Morse himself states,[44] the fact that so little scab (6.5 per ct.) developed from the untreated seed detracts somewhat from

[44] Me. Sta. Bul. 149 : 313.

the value of the results. In this experiment the quantity of potatoes was slightly above ten pounds per cubic foot. The experiment made by Jones and Morse[45] at the Vermont Station in 1905 gave more decisive results, but in this experiment the quantity of potatoes was somewhat less than 3.7 lbs. per cubic foot and the quantity of formaldehyde more than twice that of the standard formula. Further evidence that efficiency is not incompatible with safety is furnished by the earlier experiments of Jones and Morse, but these, also, were made with smaller quantities of potatoes and the gas was not generated by the permanganate method.

If, upon further investigation, it should be found (as we believe it will be) that a moderate amount of lenticel spotting does not injuriously affect germination or growth, the quantity of potatoes may be safely lowered to 5 lbs. per cubic foot (83 bushels per 1000 cubic feet).

As stated on a previous page, *uniform results as regards safety and efficiency can be obtained only by varying the quantity of chemicals according to the quantity of potatoes per cubic foot.* Further investigation is needed to determine definitely the terms of this relation. At present, it can only be said that with the standard formula of 3 pints of formaldehyde and 23 ounces of permanganate to 167 bushels of potatoes in 1000 cubic feet (10 lbs. per cubic foot) there will be no injury to the tubers and, probably, scab will be fairly well controlled.[46] No other proportions can be confidently recommended. It is probable that doubling or halving the quantity of both chemicals and potatoes will give similar results, but further experiments are necessary to establish this.

Aside from what is said above concerning the quantity of potatoes per cubic foot of space we approve the directions for treatment given by Morse in Maine Station Bulletins 141, 149 and 174 except, perhaps, in one respect, viz., the advisability of exposing the tubers in ordinary bushel crates. According to our observation the gas does not readily penetrate to the interior of bushel crates. More uniform results would be obtained if the tubers were exposed in slatted bins only a few inches deep and so arranged that the gas can circulate freely above and below them.

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[45] Vt. Sta. Rpt. 18 : 287-291.

[46] This statement in regard to the efficiency of the treatment is based on the results of Morse's experiment at Houlton, Me.

THE EFFICIENCY OF FORMALDEHYDE IN THE TREATMENT OF SEED POTATOES FOR RHIZOCTONIA.*

W. O. GLOYER.

SUMMARY.

The object of this investigation was to determine the relative efficiency of the standard scab treatments in the disinfection of seed potatoes affected with Rhizoctonia. Experiments were made with formaldehyde gas, formaldehyde solution, and corrosive sublimate solution.

It was found that neither formaldehyde gas nor formaldehyde solution can be depended upon to kill all of the Rhizoctonia sclerotia. The principal reason for this appears to be the inability of the formaldehyde to penetrate readily to the center of the larger and more compact sclerotia. Also, the efficiency of the gas treatment depends to a considerable extent upon the quantity of tubers per cubic foot of space in the disinfection chamber. Other things being equal, the smaller the quantity of potatoes the greater the efficiency. Neither temperature nor humidity are factors of much importance.

The standard corrosive sublimate treatment, on the contrary, is thoroughly efficient. Even with a 1-to-2000 solution (half standard strength) all Rhizoctonia sclerotia are killed.

The conclusion reached is, that when it is desired to treat seed potatoes for Rhizoctonia the corrosive sublimate treatment should be used.

INTRODUCTION.

The numerous fumigation experiments made in the course of the investigation reported in Bulletin No. 369 of this Station offered an excellent opportunity for observing the effect of formaldehyde gas on the Rhizoctonia adhering to potato tubers. Potatoes in various quantities and under various conditions of temperature and moisture were subjected to the formaldehyde gas treatment, and the effect on Rhizoctonia noted. In other experiments Rhizoctonia-infested tubers were dipped in solutions of formaldehyde and corrosive sublimate as

*Reprint of Bulletin No. 370; for Popular Edition, see p. 778.

recommended for the prevention of scab. The effect of the treatment was determined by comparing the growth of the Rhizoctonia in artificial cultures made before and after treatment. In this respect, our methods differ from those used by previous investigators. Heretofore, the efficiency of the treatment has been determined, in most cases, by means of field experiments and the results have been more or less unsatisfactory. They have been affected by outside factors such as climatic conditions, texture and drainage of the soil, insects and other fungus diseases. By the culture method such factors are eliminated.

THE DISEASE.

The disease under consideration is that caused by *Rhizoctonia solani* Kühn which is the sterile form of *Corticium vagum* B. & C. var. *solani* Burt.[1] It has been known in Europe for many years. Its occurrence in America was first reported by Duggar and Stewart[2] in 1901, and it is now found in all portions of this country where the potato is extensively grown. It is recognized on the surface of the tubers by the masses of resting mycelium or sclerotia. These sclerotia-like bodies are often overlooked, for they may be mistaken for soil clinging to the potato. By immersing the tubers in water or washing them free from all soil, the sclerotia can readily be distinguished as dark brown bodies which cling tenaciously to the surface of the tuber. Plate III shows a tuber with the sclerotial bodies upon it. When the fungus is in this form it is of little importance as the tubers are not injured by it, but affected tubers may disseminate the disease, and in very bad cases the market value of the tubers may be lowered.

To this fungus is attributed, to a great degree, the so-called "skips" in the planted row. Rolfs,[3] in 1902 and 1904, held it responsible for the failure of potato crops in Colorado. The fungus may live on the organic matter in the soil or it may live as a parasite attacking the stems, stolons, or roots of the plants. At the point of attack, cankers are formed which in time may increase so

[1] Probably the same as *Hypochnus solani* Prill. & Delacr. (Clinton, Conn. Sta. Rpt. for 1904 : 326; Riehm, *Mitt. K. Biol. Anst. f. Land u. Forstw*, 11 : 23. 1911).

[2] Duggar, B. M., and Stewart, F. C. The Sterile Fungus Rhizoctonia. Cornell Sta. Bul. 186. 1901; also N. Y. (Geneva) Sta. Bul. 186. 1901.

[3] Rolfs, F. M. Potato Failures. Colo. Sta. Bul. 70. 1902; and Bul. 91. 1904.

Plate III.— Potato Tubers Bearing Rhizoctonia Sclerotia. (Natural size.)

as to girdle the plant or separate portions from the main stem. That a wound appears to be necessary for the fungus to enter the tissue is suggested by Clinton's[4] observations. He has found the "inconspicuous grayish mealy growth" of the Corticium or fruiting stage on the stalks of the potatoes near the surface of the ground, and no injury was done to the stem at that point. He visited several fields and found that 15 to 20 per ct. of the plants showed this condition. To this same fungus Selby[5] attributes the rosette of the potato, and Rolfs[6] reports that the occurrence of aerial tubers may be explained partially by its presence. However there is no doubt that other factors may bring about similar effects.

PREVIOUS LITERATURE.

Since Loew's discovery[7] of the germicidal action of formaldehyde, in 1888, a great deal has been written on the subject of fumigation and disinfection for bacteria and fungi. The disinfection of seed potatoes was first taken up by Bolley[8] who has recommended the use of corrosive sublimate (mercury bichloride) solution for potato scab. Later, Arthur[9] found that a formaldehyde solution gave just as good results and was safer to handle. These experiments have been repeated and the conclusions confirmed by numerous other experimenters. The formaldehyde gas treatment for seed potatoes orginated with Jones and Morse as described in Bulletin No. 369, page 386.

It is generally taken for granted that the treatment made for scab is also effective in killing Rhizoctonia. Rolfs[10] conducted extensive field tests of the dip method of treating Rhizoctonia, and concluded that the mercury bichloride solution was effective in controlling it; also that formaldehyde solution gave less favorable results. Selby,[11] in his first report on the potato rosette (which

[4]Clinton, G. P. Report of Botanist. Conn. Sta. Rpt. for 1904:325.
[5]Selby, A. D. A Rosette Disease of Potatoes. Ohio Sta. Buls. 139 and 145. 1903.
[6]*Loc. cit.* Bul. 70.
[7]Loew, O. Physiologische Notizen über Formaldehyd. Ber. Gesell. Morph. u. Phys. zu Munchen. 1888.
[8]Bolley, H. L. Potato Scab and Possibilities of Prevention. N. Dak. Sta. Bul. 4. 1891.
[9]Arthur, J. C. Formaldehyde for Prevention of Potato Scab. Ind. Sta. Bul. 65. 1897.
[10]*Loc. cit.* Bul. 91.
[11]*Loc. cit.* Bul. 139:58.

he attributed to Rhizoctonia), believes the formalin more effective than the corrosive sublimate bath. He has noted the yields of the treated and untreated tubers and used the appearance of the foliage as a criterion in determining the effectiveness of the treatment. He states, "the warranted conclusion, drawn from tests of two seasons (1901 and 1902) with formalin and the extended work of many seasons at the Station with corrosive sublimate appears to be that corrosive sublimate seed treatment does not prevent the Rhizoctonia disease to any appreciable extent, while the formalin seed treatment, as shown conspicuously by study of the growing plants and usually in the yields of tubers, does prevent the disease to a very marked extent." In Selby's second report[12] of his investigations on the treatment of Rhizoctonia, there are recorded experiments in which treated and untreated tubers were planted in infected soil as well as in soil in which the disease was not supposed to be present. The Carman variety is the only one that received treatment with the standard substances and was planted in infected soil and grown apparently under similar conditions. He used formalin at the rate of one pound (pint) to 30 gallons of water, immersing the tubers for two hours. It is uncertain what strength of mercury bichloride solution was used for he states, "the usual strength of one ounce to 16 gallons of water was employed," and in this solution the tubers remained for one hour. However, this is one-half the strength used by Bolley[13] who recommends one ounce to 7½ gallons of water, and an immersion for 1½ hours. The average yields from the check, formalin, and corrosive sublimate treated plots are calculated at 139.9, 131.4, and 127.1 bushels per acre, and the percentages of harvested tubers showing Rhizoctonia are 62, 46, and 29.5 per ct., respectively. The yields from the treated tubers are slightly smaller than those from the untreated, but the least percentage of Rhizoctonia is found on the product of tubers treated with mercury bichloride solution.

Selby also treated Rhizoctonia-infested tubers with formaldehyde solution for various periods of time. The Early Trumbull variety was immersed in standard formalin solution for 2, 3½, and 4½ hours and planted in infected soil under apparently similar conditions. The check plots showed 94 per ct. of the harvested tubers infected with Rhizoctonia, while the tubers treated for 2, 3½, and 4½ hours

[12] *Loc. cit.*
[13] *Loc. cit.*

showed 87, 45, and 48 per ct. of the tubers attacked by it. Though no comment was made on these results it appears that a longer immersion than two hours is more effective in killing the fungus.

Güssow [14] conducted field experiments in which lots of seed tubers attacked by Rhizoctonia were immersed for 3 hours in a solution of one part mercury bichloride to 2000 parts of water (equal to 1 ounce to 15 gallons of water), and, also in a bath of formalin made up of one half pint to 15 gallons of water. At the harvest it was found that the tubers treated with formalin were almost as badly covered with Rhizoctonia as were the original potatoes, while those immersed in mercury bichloride solution were practically free.

PRESENT TESTS.

METHODS.

To ascertain the efficiency of the formaldehyde gas, three or more Rhizoctonia-infected potatoes were placed in the fumigator along with the various quantities of tubers that were used in the experiments made for the determination of factors involved in tuber injury. The chemicals used, the fumigator, the quantity of tubers, and the conditions of moisture and temperature under which these experiments were conducted are described in Bulletin No. 369.

For comparison with the results obtained by the gas method of treating seed potatoes, experiments were also conducted in which the standard immersion or dip methods were employed. Rhizoctonia-diseased tubers were immersed in solutions of formaldehyde and mercury bichloride for 2 and 1½ hours respectively. The standard strength of formalin was used unless otherwise noted, namely, one pint of formalin (a 37 per ct. solution of formaldehyde) to 30 gallons of water. Of mercury bichloride, two different strengths were used, namely, one part of the salt to 1000 and 2000 parts of water. The latter strength is one-half that usually employed in practical disinfection. After immersion in these solutions the potatoes were permitted to drain and dry under sterile conditions.

Before and after each experiment cultures were made of the untreated and treated sclerotia to determine the efficiency of the treatment. In making these cultures the usual precautions were used to maintain sterile conditions in handling instruments, petri

[14] Güssow, H. T. Canada Expt. Farms Rpts. 1912:200.

dishes, potatoes, etc. At the outset, sclerotia were placed on potato agar of one per ct. acidity, but it was found that the plates were soon overrun by the potato bacillus. This was generally the case when sclerotia from untreated or formaldehyde-treated tubers were taken. The spores of this bacillus (*Bacillus vulgatus* Trevisan) are very resistant, and are invariably found on potatoes. An idea of their resistance can be secured from the fact that the usual method of obtaining this organism is by boiling potatoes for one-half hour, halving them, and incubating in a sterile moist chamber.[15] These bacteria were kept down by adding two drops of 50 per ct. lactic acid to each tube of about 10 cubic centimeters of the medium. By omitting the lactic acid, the effect of the treatment on the bacteria that are found in the sclerotia and on the surface of the tuber was determined.

That Rhizoctonia on acidulated agar grows well without interference from bacteria has been noted by Duggar and Stewart.[16] However, Duggar later states that Rhizoctonia is apparently not readily affected by weak alkalies or acids.[17] F. C. Stewart, in some of his unpublished work on the carnation Rhizoctonia, has shown that the growth of the fungus is more rapid on agar which is slightly acid than on neutral or slightly alkaline media, while on more strongly acidulated agar the growth again becomes less rapid. In the writer's work it was found that when two drops of 50 per ct. lactic acid were added to a tube containing about 10 cubic centimeters of one-per-ct. acid potato agar, the growth of potato Rhizoctonia was about one-half as fast as on the same medium without the lactic acid. In Tables I–III these two kinds of agar are designated as "strongly acid agar" and "agar, one per ct. acid."

Generally, five sclerotia were placed in each petri dish and allowed to develop at room temperature. After three to five days the nature of the results from the untreated sclerotia could be ascertained. In case of the treated sclerotia, the cultures were examined from time to time and kept ten days before they were discarded. At the end of ten days the cultures were examined by means of the low power of the microscope.

[15] Frost. Laboratory Bacteriology, p. 95. 1909.
[16] *Loc. cit.* N. Y. (Geneva) Sta. Bul. 186 :7.
[17] Duggar, B. M. Fungous Diseases of Plants, p. 453. 1909.

Table I shows the results of the cultures made from sclerotia taken from untreated tubers and tubers subjected to the formaldehyde gas treatment. Unless otherwise stated, the quantities of the chemicals used in the fumigator are 14.25 grams of potassium permanganate and 30 cubic centimeters of formalin, which is equal to 23 ounces of the salt and 3 pints of the liquid for every 1000 cubic feet of space. The exposure was usually for 24 hours and any change in exposure is noted. Where the quantity is expressed in pounds, it is to indicate the number of pounds of tubers per cubic foot of space in the fumigator; otherwise, the number given shows the total number of tubers exposed at one charge. As each experiment is numbered, the condition of the potatoes before they went into the fumigator and the effect of the gas upon them can be readily learned by referring to the corresponding experiments in Tables I and II, Bulletin No. 369. The data in regard to the efficiency of the gas treatment are summarized in Table II of the present bulletin; while Table III shows the results of experiments in which the liquid treatment was used.

TABLE I.—EFFECT OF FORMALDEHYDE GAS ON THE SCLEROTIA OF RHIZOCTONIA.

QUANTITY OF POTATOES.	TREATED.												UNTREATED.						
	Number of experiment.	HUMIDITY.			TEMPERATURE.			NUMBER OF CULTURES ON STRONGLY ACID AGAR.*					AGAR, 1 PER CT. ACID.		NUMBER OF CULTURES ON STRONGLY ACID AGAR.				
		Initial.	Maximum.	Closing.	Initial.	Maximum.	Minimum.	Sterile.	Showing growth of Rhizoctonia.	Other fungi.	Total.	Percentage Rhizoctonia.	Bacterial colonies.	Sterile.	Sterile.	Showing growth of Rhizoctonia.	Other fungi.	Total.	Percentage Rhizoctonia.
Tubers.		*Per ct.*	*Per ct.*	*Per ct.*	*Deg. F.*	*Deg. F.*	*Deg. F.*					*Per ct.*							*Per ct.*
36	59	45	—	77	50	58	—	13	2	0	15	13	4	1	1	12	2	15	80
36	65	48	88	79	63	66	57	15	0	0	15	0	0	5	2	2	6	10	20
23	72	71	96	83	53	61	53	15	0	0	15	0	—	—	0	9	6	15	60
23	73	50	89	82	68	71	60	15	0	0	15	0	—	—	1	6	3	10	60
Lbs. per cu. ft.																			
1.5	50	66	85	78	55	63	55	15	0	0	15	0	3	2	0	8	7	15	53
1.5	67	46	78	78	60	60	58	11	4	1	15	26	1	4	0	4	11	15	26
1.5	76	79	91	86	54	56	53	13	2	0	15	13	—	—	1	10	4	15	66
1.5	80	66	82	70	50	51	49	15	0	0	15	0	—	—	0	14	1	15	93
1.5	85	69	91	77	54	54	51	15	0	0	15	0	—	—	0	10	5	15	66
2	45	53	84	85	53	57	49	13	1	1	15	7	5	0	0	4	11	15	26
2	52	85	85	73	40	42	40	11	4	0	15	26	5	0	0	10	5	15	66
2	56	70	92	86	43	46	43	13	1	1	15	7	—	—	0	13	2	15	86
2	79	62	81	74	49	50	48	5	4	6	15	26	—	—	0	15	0	15	100
2	83	89	94	90	50	51	49	15	0	0	15	0	—	—	0	9	6	15	60
3	43	54	84	78	54	60	54	20	0	0	20	0	0	5	2	6	7	15	40
3	51	60	77	77	45	46	40	15	0	0	15	0	5	0	0	9	1	10	90
3	57	77	89	85	46	50	46	14	0	1	15	0	5	0	0	12	3	15	80
3	61	58	89	87	48	48	37	10	4	1	15	27	4	1	0	13	2	15	86
3	63	58	80	78	47	55	47	7	5	3	15	33	2	3	0	15	0	15	100
3	64	64	86	83	65	65	55	15	0	0	15	0	5	0	0	13	2	15	86
3	66	51	80	78	69	69	61	7	2	1	10	20	5	0	0	7	3	10	70
4	42	61	87	76	54	58	53	15	0	0	15	0	5	0	0	7	8	15	47
4	47	66	77	76	62	68	62	15	0	0	15	0	5	0	0	7	8	15	47
4	58	62	91	91	49	50	45	9	5	1	15	33	5	0	0	15	0	15	100
4	70	59	88	88	47	51	47	12	3	0	15	20	—	—	0	10	5	15	66
4	77	80	89	83	53	55	52	12	8	0	15	20	—	—	0	14	1	15	93
4	84	90	96	91	50	52	50	13	1	1	15	7	—	—	1	12	2	15	80

*The acidulation of media is described on page 222.

5..............	41	60	90	89	54	57	54	15	0	0	15	0	5	0	2	4	9	15	27
6..............	29	40	74	73	64	67	57	20	0	0	20	0	—	—	6	3	6	15	33
8..............	27	62	73	73	53	55	52	24	1	0	25	4	5	0	4	10	7	21	47
8..............	53	83	87	81	40	42	40	11	3	1	15	20	5	0	1	6	8	15	40
8..............	60	49	94	94	59	59	49	9	6	0	15	40	5	0	0	14	1	15	93
8..............	74	47	94	94	78	87	70	34	5	1	40	12.5	3	0	0	14	1	15	93
10..............	25	75	92	92	46	48	44	25	3	5	33	9	5	0	0	8	12	20	40
12..............	22	80	90	89	51	54	51	29	0	1	30	0	5	0	3	7	10	20	35
12..............	54	88	93	93	42	42	42	14	7	4	25	28	5	0	1	9	15	25	38
12..............	62	44	79	79	41	44	41	10	3	2	15	20	5	0	0	12	3	15	80
12..............	75	67	96	96	65	65	53	22	16	2	40	40	5	0	0	15	0	15	100
14..............	19	89	98	96	52	53	50	13	2	5	20	10	—	—	1	4	8	13	31
16..............	13	65	78	78	46	53	46	8	11	1	20	55	5	0	2	3	10	15	20
16..............	16	51	79	79	51	52	49	21	4	0	25	18	10	0	0	11	4	15	78
16..............	55	93	94	93	43	43	43	15	3	2	20	15	5	0	0	15	......	15	100
16..............	86	51	104	*104	59	59	54	22	12	11	45	26	—	—	0	8	7	15	53
Exposed for three hours.																			
23 tubers......	68	88	95	95	51	52	51	10	9	1	20	45	5	0	0	15	0	15	100
23 "	69	95	100	100	52	54	52	20	0	0	20	0	0	5	0	15	0	15	100
23 "	71	52	93	93	48	50	48	12	3	0	15	20	—	—	0	12	3	15	80
Lbs. per cu. ft. *Exposed for 24 hours, but double quantity of chemicals were used.*																			
4..............	78	75	93	89	52	54	50	18	1	1	20	5	—	—	0	15	0	15	100
3.7..........Dry	89	—	—	—	46	—	45	25	9	6	40	22.5	—	—	2	5	18	25	20
3.7.........Wet	89	—	—	—	46	—	45	47	1	2	50	2	—	—					

*No doubt there was a supersaturated atmosphere in the fumigator for when it was opened (fumigator was out in the rain) the relative humidity fell to 100 per ct.

TABLE II.—EFFECT OF FORMALDEHYDE GAS ON RHIZOCTONIA; SUMMARY.

QUANTITY OF POTATOES.	Number of experi-ments.	TREATED. Total number of cultures.	TREATED. Average percentage showing growth of Rhizoc-tonia.	UNTREATED. Total number of cultures.	UNTREATED. Average percentage showing growth of Rhizoc-tonia.
			Per ct.		Per ct.
Exposed for 24 hours: Standard charge.					
23 to 36 tubers............	4	60	3.3	50	55
1.5 lbs. per cu. ft........	5	75	7.8	75	60.8
2 " "	5	75	15.2	75	67.4
3 " "	7	105	11.4	95	78.8
4 " "	6	90	13.3	90	72.1
5 " "	1	15	0	15	27
6 " "	1	20	0	15	33
8 " "	4	95	19.3	66	68.2
10 " "	1	33	9	20	40
12 " "	4	110	22	75	63.2
14 " "	1	20	10	13	31
16 " "	4	110	28.5	60	54
Exposed for 3 hours.					
23 tubers.................	3	55	21.6	45	93.3
Exposed for 24 hours, but double quantity of chemicals.					
4 lbs. per cu. ft...........	1	20	5	15	100
3.7 lbs. per cu. ft., dry.....	1	40	22.5	25	20
3.7 lbs. per cu. ft., wet.....	1	50	2		

DISCUSSION OF RESULTS.

The data given in Table I and summarized in Table II, show that the formaldehyde gas treatment is not reliable; that is, it is not efficient in killing Rhizoctonia and some other fungi and bacteria which occur on the surface of the seed potatoes. Humidity and temperature do not appear to be responsible for the irregularities in the efficiency of the treatment. Where several experiments were conducted with equal quantities of tubers, the average results of such experiments show that there is a lesser degree of efficiency when there is a large quantity of tubers in the fumigator. However,

in individual cases where small quantities of tubers are used, the percentage of Rhizoctonia not killed may be almost as high as the average percentage for large quantities of tubers.

TABLE III.—EFFECT OF FORMALDEHYDE AND CORROSIVE SUBLIMATE SOLUTIONS ON RHIZOCTONIA.

Number of experiment.	Proportions.	Time of immersion.	Temperature C.	Number of cultures on strongly acid agar.					Agar, one per cent acid.	
				Sterile.	Showing growth of Rhizoctonia.	Other fungi.	Total.	Percentage showing growth of Rhizoctonia.	Bacterial colonies.	Sterile.
	FORMALIN SOLUTION.									
1....	1-240	2 hrs.	17.5	12	0	3	15	0	15	0
2....	1-240	2 "	19	73	22	17	112	20	30	0
3....	1-240	2 "	19	16	10	34	60	17	10	0
4....	1-240	2 "	19	6	8	16	30	21	10	0
5....	1-240	2 "	21	23	8	4	35	23	5	0
6....	1-240	2 "	19.5	1	16	8	25	64	——	——
7....	1-240	2 "	22.5	6	4	15	25	18	——	——
8....	1-240	2 "	20	9	10	6	25	40	——	——
Total and average.....			19.6	146	78	103	327	23.85	70	0
1....	1-240	24 "	17.5	5	0	0	5	0	5	0
5....	1-240	24 "	21	18	0	2	20	0	3	2
6....	1-240	6.75"	19.5	8	0	2	10	0	5	0
9....	1-60	2 "	21	49	3	8	60	5	7	3
10....	1-20	2 "	18	15	0	0	15	0	1	4
	MERCURY BICHLORIDE (CORROSIVE SUBLIMATE) SOLUTION.									
3....	1-1000	1.5 "	19	60	0	0	60	0	0	10
4....	1-1000	1.5 "	19	40	0	0	40	0	0	10
9....	1-1000	1.75"	21	70	0	0	70	0	0	10
5....	1-2000	1.5 "	21	40	0	0	40	0	0	5
6....	1-2000	1.5 "	19.5	27	0	0	27	0	2	3
7....	1-2000	1.5 "	22.5	20	0	0	20	0	——	——
8....	1-2000	1.5 "	20	40	0	0	40	0	——	——
Total and average......			20	297	0	0	297	0	2	38

In Experiment 89 (Table I), there is compared the efficiency of formaldehyde gas on the sclerotia having different moisture content.

In this experiment, the tubers designated as dry were cleaned by dusting off the excess dirt, while the tubers designated as wet were washed with water. Just previous to placing these potatoes in the fumigator, the washed tubers were immersed in distilled water for 45 minutes, and then all excess water was wiped from the surface. The 80 pounds (equal to 3.7 pounds per cubic foot) of potatoes were subjected for 24 hours to the gas evolved from a double quantity of chemicals. Sclerotia of about the same size and texture were used in making the cultures. As there was a slight leakage of the gas from the fumigator these results are only comparative. Of the 40 sclerotia taken from the dry tubers, 22½ per ct. developed Rhizoctonia, while from the 50 moistened sclerotia but 2 per ct. showed growth. This experiment indicates that the state of dessication of the sclerotia has an important bearing on the results of fumigation. One would be led to believe that the humidity of the atmosphere ought to have some effect on the efficiency of this gas, but the data in Table I show no correlation between humidity and efficiency.

The data in Table III show that by the formalin dip method as high as 64 per ct. of the sclerotia may still be alive after the treatment, and an average of 8 tests shows that 24 per ct. of the sclerotia were not killed. A longer period of immersion of the tubers gave more satisfactory results than did a two-hour bath, but the deficiency of the treatment can not be overcome by using a stronger solution.

That the formaldehyde, when used in any form, did not kill resistant spores of the potato bacillus when they were inside the sclerotia or particles of soil, is shown where "agar, one per ct. acid" was used as a culture medium. In fact, so prevalent was this organism that it was impossible to make cultures unless additional acid was added to the medium. That other fungi are not killed by formaldehyde treatments when these organisms are inside of the sclerotia is noted in Table I–III under the heading "other fungi." Most of these fungi were species of Penicillium, but several were uncommon or produced no spores, and no effort was made to identify them.

Where a solution of mercury bichloride of a strength of one part of the salt to 1000 parts of water was used, there was no indication of the growth of Rhizoctonia or of any other fungus or bacterium. Even where half of the above amount of salt was used to a like

amount of water the Rhizoctonia was entirely killed. With a total of 297 cultures the efficiency of mercury bichloride in killing the potato Rhizoctonia was 100 per ct.

The inefficiency of formaldehyde can not be attributed to any single cause, for there are several factors which, when combined, may produce variable results. While making cultures of the sclerotia taken from tubers immersed in formaldehyde solution, it was found that the larger sclerotia were often not moistened throughout. Such sclerotia showed a compact, dry mass of mycelium at the center from which the fungus readily grew. The outer layers, however, were spongy and readily crumbled. In some cases the compact small sclerotia showed the same conditions generally found in the larger ones. The weak penètrative power of formaldehyde may be explained, perhaps, by assuming that the formaldehyde unites chemically with the outer layers of sclerotial tissue forming some substance that retards or inhibits further penetration. This is substantiated by the fact that when tubers are immersed in the ordinary formaldehyde solution for 24 hours the sclerotia are all killed, and it is found that the liquid has penetrated them throughout. Dienes,[18] working on the penetration of formaldehyde gas, has shown that after 14 hours bacteria were killed by the gas penetrating through a porous porcelain plate 20 mm. thick. The structure and composition of the sclerotia, however, is not analogous to that of a porous plate for in the former the compact mass of resting mycelium is more or less in a state of dessication, which affects the rate of penetration of this chemical. Mercury bichloride, unlike the formaldehyde, penetrates all sclerotia, regardless of size or compactness, in 1½ hours. Such sclerotia are all killed, and readily crumble into small pieces when crushed. In the formaldehyde gas treatment, the temperature and humidity, as usually encountered, do not appear to be factors that influence the efficiency. McClintic,[19] in disinfecting passenger cars with formaldehyde gas, states that humidity is an important factor in killing bacteria. He maintains that before starting the fumigation the relative humidity should not be lower than 60–65 per ct. In his earlier work

[18] Dienes, L. Uber Tiefwirkung des Formaldehyds. *Ztschr. Hyg. u. Infectionskrank.* 37:43. 1912.

[19] McClintic, T. B. Pub. Health and Marine Hosp. Ser. U. S. Hyg. Lab. Bul. 27. 1906.

on the treatment of the potato scab, Morse[20] states that a temperature of 60–65 degrees Fahr. is more effective than a lower one, and that in moist air the gas is more efficient. Later[21] he states that a temperature above 80 degrees is most effective. However, under ordinary farm conditions, unless specially equipped, it is almost impossible to obtain a temperature of 80 degrees when it is most desirable to treat tubers. In the preceding bulletin, No. 369, temperature does not prove a factor in determining the cause of the injury to the tubers, but humidity shows some evidence of being a causal agent. The data in Table I of the present bulletin, however, indicate that temperature and humidity are less important in the treatment for Rhizoctonia than is usually believed, for under almost similar conditions widely variable results were obtained. One of the most important factors concerned in the inefficiency is the quantity of tubers in the fumigator. Where several experiments were conducted with the same quantity of tubers the averages show least efficiency where potatoes at the rate of 16 pounds (equal to 167 bushels per 1000 cubic feet) per cubic foot were used. In Bulletin No. 369 it is shown that the factor of adsorption is dependent upon the quantity of tubers in the fumigator. The writer believes that if a sufficient number of experiments were conducted the data would show that there is a gradual decrease in the efficiency of the gas as the quantity of tubers is increased.

The conclusion drawn from laboratory experiments that the formaldehyde gas and liquid treatments are inefficient in killing the Rhizoctonia is partially substantiated by other writers. Rolfs[22] and Güssow[23] conclude, from the results of field experiments, that the mercury bichloride gives better results than the formaldehyde solution. Selby[24] came to an opposite conclusion, namely, that the formalin dip method was better than the corrosive sublimate treatment. However, so far as the control of Rhizoctonia is concerned this conclusion appears unwarranted. The plats in his experiments were very small, mostly on infected soil and the yields irregular. Moreover, the causal relation of Rhizoctonia to rosette is uncertain.

[20] Morse, W. J. Potato Diseases in 1907. Me. Sta. Bul. 149:316. 1907.
[21] Morse, W. J. Blackleg: A Bacterial Disease of Irish Potato. Me. Sta. Bul. 174:325. 1909.
[22] Rolfs, F. M. Colo. Sta. Buls. 70 and 91.
[23] Güssow, H. T. Canada Expt. Farms Rpts. 1912:200.
[24] Selby, A. D. Ohio Sta. Buls. 139 and 145. 1903.

The field experiments of many writers indicate that formaldehyde is as efficient as the mercury bichloride solution in killing potato scab, but there are certain indications that make it appear doubtful if such is actually the case. The difficulty with which formaldehyde penetrates Rhizoctonia sclerotia, and its inability to kill certain other fungi and the potato bacillus suggest that it may, sometimes, be unable to reach and kill the scab organism which, according to Lutman,[25] may be imbedded in the corky tissue of the scab lesions. Also, since adsorption plays such an important role in the formaldehyde gas treatment the efficiency would be least where a large quantity of tubers was fumigated. Unfortunately, the culture method can not be used successfully in determining the efficiency of the treatment on scab. Although it is not difficult to obtain pure cultures of the scab organism it does not grow on culture media readily enough to make this method practicable.

The results of this investigation, considered in connection with those recorded in Bulletin No. 369, seem to warrant the following conclusions: The disinfection of seed potatoes by means of formaldehyde gas is not to be recommended except in cases in which it is impracticable to use either of the liquid treatments. When the treatment is applied for scab alone either corrosive sublimate solution or formaldehyde may be used; but when both Rhizoctonia and scab are involved the corrosive sublimate solution is to be preferred.

[25]Lutman, B. F. The Pathological Anatomy of Potato Scab. *Phytopathology* 3:261. 1913.

REPORT

OF THE

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TABLE OF CONTENTS.

REPORT OF THE DEPARTMENT OF CHEMISTRY.

STUDIES IN PLANT NUTRITION: I.*

W. H. JORDAN.

SUMMARY.

(1) Three questions have been studied by growing plants in a forcing house in artificial soils under varying conditions of plant food supply, viz.:

(a) The relative availability to certain species of plants of phosphoric acid in various combinations, acid phosphate, a finely ground raw phosphate (floats), Thomas slag, dehydrated Redonda phosphate and bone meal; (b) the effect of fineness of division upon the availability of a ground raw phosphate; (c) the fertilizing value of an iron ore waste.

(2) The results reached show that certain species of plants possess a greatly unlike ability to acquire phosphoric acid from given sources. The cruciferous plants, cabbage and rape, utilized freely the phosphoric acid from ground Florida rock (floats) while with the graminaceous plants, barley, millet and oats, this form of phosphoric acid had small availability, if any.

(3) Taking the several species of plants as a whole, the acid phosphate proved to be more efficient in the production of plant substance than any other source of phosphoric acid, although it showed no great superiority over Thomas slag. The phosphoric acid in the dehydrated Redonda phosphate, though less available than in the two forms mentioned, proved to be much more available than in the floats.

(4) Crops were grown during two seasons with the use of ground Florida rock and ground bone, the former varying in fineness from that which would pass through a sieve 60 meshes to the inch to "floats," the bone meal ranging from 60 mesh material to "fine," the latter being a grade finer than that which would pass through a bolting cloth. With three successive crops of rape grown after one application of the phosphates, the effect of fineness was not marked, but with the peas, barley and rape grown in 1903-4 on an improved artificial soil the availability of phosphoric acid in the Florida rock to all three crops, meas-

* Reprint of Bulletin No. 358, February, 1913.

ured by the amount appropriated, was greatly influenced by the degree of fineness, the amount taken up from the floats being at least one-half more than what was used from the coarsest material. With bone meal the degree of fineness has little influence, if any. Much the largest appropriation of phosphoric acid was from the acid phosphate.

(5) The proportion of phosphoric acid to the growth of dry matter in the plants increased with the increase in fineness of division of the Florida rock, or, in other words, in proportion to the availability.

(6) Similar tests proved the phosphoric acid in an iron ore waste to be of slight availability for plant growth.

INTRODUCTION.

Soil problems in their relation to crop production are complex and difficult. This is necessarily so because of the numerous factors that are involved in soil fertility. As our knowledge has broadened, we have come to see that the maintenance or development of the productive capacity of a farm requires attention to much more than the mere saving or purchase and application of manures.

The factors which have a practical relation to soil fertility may be classified in a general way under three heads:

(1). Soil conditions, such as color and texture, in their relation to the welfare of the plant, these conditions depending primarily upon soil composition.

(2). The supply of plant food both as to its kind and quantity.

(3). The life activities of the soil that have to do with the acquisition and development of available plant food.

Formerly the plant food supply was the factor chiefly considered and emphasized. It is now minimized by some writers and investigators to a position of much less importance than is attributed to soil conditions. It is urged that land becomes infertile not because of a depletion in the quantity of the needed elements of plant food but because, for instance, by unwise management the texture and consequently the water-holding and water-transmit-

ting power of the soil have become unfavorable to the growth of agricultural plants, or because the soil has become charged with compounds having a deleterious effect on plant growth.

It is certainly important to a system of farm economics to understand the relative importance of plant food supply. The farmer should certainly be enabled to understand whether he should continue to place emphasis upon the acquisition and saving of manurial substances or whether by certain methods of management he may look with more or less indifference upon the income and outgo of those substances, such as nitrogen, phosphoric acid and potash, for which at the present time such enormous expenditures are being made by farmers.

It is firmly believed at the present time, by practitioners at least, that under the conditions of agricultural practice that prevail plant food supply is one of the determining factors in crop production. If this belief is correct then measurements of soil fertility and a study of the conditions which affect the ability of the plant to appropriate the necessary materials for growth are very important.

We must at least consider the following factors:

(1). The adaptability of the plant to the securing of the necessary supply of food under given conditions.

(2). The forms in which the plant food is supplied.

(3). The quantity of the supply.

(4). The relation between soil composition and plant growth.

During the past ten or more years the writer and his associates have secured certain data, so far unpublished, which bear directly upon the problems here suggested. The experiments that have been conducted have been directed toward these questions:

Are different forms of phosphoric acid equally available to various species of plants?

Does the mechanical fineness of a crude phosphate influence its availability?

How close is the relation of the supply of phosphoric acid and potash to the amount appropriated by the plant?

What is the relation of soil composition and the solubility of soil constituents to fertility?

Minor related questions also arose as the work advanced.

It had been the intention of the writer not to publish some of these data because they are practically a repetition of emphatic results previously reached, but in view of the newer phases of the discussions of soil fertility it is deemed wise to make these data public.

This bulletin is, therefore, the first of a series in which are set forth the results of experiments in the field of plant nutrition that have been carried on during the past ten or twelve years. The publication of these results has been long delayed partly because of the large amount of chemical work involved.

Those of my associates who have aided in carrying on these experiments are C. G. Jenter, F. D. Fuller, W. E. Tottingham, E. B. Hart and E. L. Baker; and due acknowledgment is hereby made of the execution by these gentlemen of the details of the experiments and the necessary chemical work.

THE AVAILABILITY TO CERTAIN SPECIES OF PLANTS OF PHOSPHORIC ACID FROM VARIOUS SOURCES.

GENERAL CONSIDERATIONS.

Considered merely from the standpoint of quantity phosphoric acid is the most important ingredient of commercial fertilizers. It is probably true also that no other ingredient is used with greater profit. On the average, the various brands of fertilizers contain larger proportions of it than of either nitrogen or potash. Indeed, the material bearing phosphoric acid may properly be considered the basis of practically all compounded brands.

The main sources of phosphoric acid are the deposits of mineral phosphates found in various parts of the United States and in other countries. These natural forms are used in comparatively small quantities in crop production. Phosphoric acid comes to the farm mostly in combinations that have been produced by the chemical

treatment of ground phosphatic rock. This treatment is given at a large expense for the purpose of rendering the phosphoric acid more available to growing plants. The cost of this ingredient to the farmer would be much less if this treatment were unnecessary and if the natural phosphates after mechanical preparation could be successfully and profitably used.

One of the problems in plant nutrition, economically important and to some extent scientifically interesting, is the availability to plants of the mineral phosphates after certain methods of preparation. Numerous observations have been made along this line with results that are quite definite, and we now find a recognition in practice, especially in European countries, of the usefulness of certain so-called insoluble phosphates in the production of particular crops. Of the experiments conducted in this country touching this problem, those carried on at the Maine Experiment Station during several years under forcing-house conditions, are perhaps the most extensive and have yielded the most definite and striking results. The phosphatic materials used in these experiments were acid phosphate (dissolved Florida rock), very finely ground undissolved Florida rock (floats), and Redonda phosphate, that is, a hydrated phosphate of iron and aluminum, which before using was dehydrated by the application of heat, this process rendering it much more soluble in ammonium citrate and inferentially more available to plants. The results of several years' work are summarized by Merrill in the report of the Maine Agricultural Experiment Station for 1898, page 74.

EXPERIMENTS AT THIS STATION.

After an understanding with the Director of the Maine Experiment Station, experiments similar in method and purpose to those referred to above were begun under the direction of the writer in 1896 and were continued at intervals until 1900. As the results reached were mainly confirmatory of those secured at the Maine Station, their publication was for a time not considered to be a matter of especial importance as the conclusions reached would not add in any especial manner to existing knowledge. In view,

however, of some of the more recent theories that have been propounded with relation to the nutrition of plants, it is felt that these additional data should be made public.

Plan of the experiments.—The forms of phosphoric acid used in these experiments included all of those used at Maine with the addition of Thomas slag and bone meal.

This makes the list as follows:

1. Acid phosphate (dissolved Florida rock).
2. Finely ground Florida rock (floats).
3. Thomas slag.
4. Dehydrated Redonda phosphate.
5. Bone meal.

The method followed for comparing these materials has been to apply in available form to all the experimental boxes equal amounts of the needed constituents of plant food other than phosphoric acid, this ingredient being added in the combinations previously indicated. The form of phosphoric acid being the only variable factor, any differences in crop production from the several sets of boxes may reasonably be attributed to the comparative availability of the phosphatic materials used. This is the most rational explanation, at least.

The "soil" in which the plants were grown in the several experiments was as follows:

1896–7. Natural sandy soil, supposedly poor, from pine plains near the Station, 110 pounds per can.

1898–9. Quartz sand, from Corning Glass Works, containing 99.5 to 99.7 per ct. SiO_2, (which was bought, undoubtedly, from the Berkshire Glass Sand Company, Cheshire, Mass.,) 46 pounds per box, with 12 pounds of coarse material for drainage.

1899–1900. In part with some crops the same sand that was used in 1898–9 from which the roots of the 1898–9 crops had been removed, and with some crops entirely new sand of the same kind and in the same quantity.

The cans and boxes were located in the Station forcing houses, the water being taken from the ordinary city supply; viz., a combination of lake and spring water.

Table 1 shows the forms and quantities of fertilizing ingredients that were applied in 1896–7 to each box in the sets of six (6) boxes each.

TABLE I.—PHOSPHORIC ACID AVAILABILITY EXPERIMENTS: FERTILIZER INGREDIENTS USED, 1896–7.

Form of phosphate.	Amount used per box.				
	P_2O_5	N	K_2O	$MgSO_4 + 7H_2O$	$CaSO_4 + 2H_2O$
	Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Acid phosphate	4	5	10	5	....
Florida rock (floats)	4	5	10	5	5
Thomas slag	4	5	10	5	5
Redonda	4	5	10	5	5
No phosphoric acid	......	5	10	5	5
No fertilizer	......	......	......	......	....

In Table II may be seen the treatment which it was planned to give the boxes in 1898–9 when the "soil" was quartz sand.

TABLE II.—PHOSPHORIC ACID AVAILABILITY EXPERIMENTS: FERTILIZER INGREDIENTS USED, 1898–9.

Form of phosphate.	Amount used per box.						
	P_2O_5	N	K_2O	$MgSO_4 + 7H_2O$	$CaSO_4 + 2H_2O$	Fe_2Cl_6	$CaCO_3$
	Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Acid phosphate	3	2½	5	2½	.....	1	10.2
Florida rock	3	2½	5	2½	6.3	1	5.9
Thomas slag	3	2½	5	2½	6.3	1	5
Redonda	3	2½	5	2½	6.3	1	6
No phosphoric acid	.....	2½	5	2½	6.3	1	6
No fertilizer	.....	.....	.....	.....	.....	.....	.....

Only half of the nitrogen, potash and magnesia salts were mixed with quartz sand when the boxes were filled, the intention being to add the other half during the growth of the plants. The development of some of the crops did not justify the application of the entire amounts of these soluble salts, the total quantities being supplied only to the tomato plants, two-thirds the full ration being used with barley, oats, cabbage and rape and one-half with

millet, crimson clover and vetch. As stated, the applications of P_2O_5 (3 grams) were uniform throughout.

The soils used in 1898–9 were allowed to remain in the boxes until the fall of 1899, when the roots were sifted out and the boxes were replanted after bringing the supply of the important ingredients up to the following quantities:

TABLE III.—PHOSPHORIC ACID AVAILABILITY EXPERIMENTS: FERTILIZER INGREDIENTS USED, 1899–1900.

P_2O_5	4 grams	— all boxes except "*no phosphoric acid*" and "*blanks.*"
N	3.75 "	All boxes except blanks.
K_2O	7.5 "	All boxes except blanks.
$MgSO_4 + 7H_2O$	3.75 "	All boxes except blanks.
$CaSO_4 + 2H_2O$	8.4 grams	—All boxes not receiving acid phosphate except "*blanks.*"
$CaCO_3$,	12.2 grams	— All boxes except "no *phosphoric acid*" and "*blanks.*"

The second crops on the same soil (quartz sand) were as a rule not successful, only the cabbage and rape making a growth that was considered satisfactory. In January, 1900, the boxes of all crops excepting the cabbage and rape were emptied and refilled with the same weight of new sand, to which were added smaller amounts of fertilizing materials than in the previous experiments.

These quantities were as follows:

TABLE IV.—PHOSPHORIC ACID AVAILABILITY EXPERIMENTS: FERTILIZER INGREDIENTS USED, 1900.

P_2O_5	1.50 grams.	All boxes but "*no phosphoric acid*" and "*blanks.*"
N	.625 "	All boxes but blanks.
K_2O	1.25 "	All boxes but blanks.
$MgSO_4 + 7H_2O$	.50 "	All boxes but blanks.
Fe_2Cl_6	.375 "	All boxes but blanks.
$CaSO_4 + 2H_2O$	3.00 "	All boxes but blanks.
$CaCO_3$	5.00 "	All boxes but "*no phosphoric acid*" and "*blanks.*"

In all, then, a record has been made of the growth on different phosphates of three crops of several species of plants. It is believed that logical conclusions can be drawn from the data thus secured, conclusions that are in the main harmonious with the outcome of previous experiments along the same line.

Results of experiments with different phosphates on a poor natural soil from pine plains near Geneva.—For reasons that will appear later, a record was made simply of the air-dry crops grown in the 1896–7 experiments. The weights of the crops on

this basis are given in Table V. The figures given are the averages of two boxes.

TABLE V.—PHOSPHORIC ACID AVAILABILITY EXPERIMENTS: YIELD OF AIR-DRY MATTER, 1896–7.

	Oats.	Rye.	Beans.	Vetch.	Cabbage.	Rape.
	Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Acid phosphate..........	93.5	226.8	22.4	111.2	57.5	61.4
Florida rock (floats)......	85.7	205.5	13.8	85.7	53	55.2
Thomas slag.............	115.1	212.0	14.8	98.8	54.8	60.7
Redonda phosphate.......	93	215.0	16.9	87.6	53.2	59.5
No phosphoric acid.	90.7	194	13.3	75.3	53	45.8
No fertilizer.............	7.3	39.5	11.1	75.6	13	11.4

The foregoing data are not such as to permit of any comparison of the relative efficiency of the various phosphates with the different crops, because in general the boxes receiving no phosphoric acid were nearly or quite as productive as those that did. It is interesting to note, however, that the fertilizers increased the productiveness of the soil for the vetch much less than for the other crops.

Availability of various phosphates to different crops in a soil composed of quartz sand.— In these experiments determinations were made of the dry matter produced by the various boxes, and also of the quantities of phosphoric acid taken up by the several crops. Tables VI and VII show the yields of dry matter and Tables VIII and IX the quantities of phosphoric acid utilized.

TABLE VI.—PHOSPHORIC ACID AVAILABILITY EXPERIMENTS: YIELDS OF DRY MATTER ON DIFFERENT PHOSPHATES, 1898–9.

	Barley.	Millet.	Oats.	Clover.	Vetch.	Tomatoes.	Cabbage.	Rape.
	Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Acid phosphate......	189.6	29.2	210.2	93.8	88.5	58.7	82.2	91.4
Florida rock (floats)..	9.3	1.1	9.1	2.6	31.8	1.8	64.5	72.3
Thomas slag........	181.4	8.8	198.9	74	67.5	48.4	80	98.4
Redonda phosphate (dehydrated)......	150.1	14.4	170.2	37.1	61.9	57.2	65.4	74.9
No phosphoric acid...	7.9	1.2	6.8	2.4	2.7	.....	.5	.8
No fertilizer	10.9	1.1	10	4.5	2.7	.....	3.6	3.4

TABLE VII.—PHOSPHORIC ACID AVAILABILITY EXPERIMENTS: YIELDS OF DRY MATTER ON DIFFERENT PHOSPHATES, 1899-1900.

	Results with new sand.				Results with sand used in 1898-9.	
	Barley.	Peas.	Vetch.	Tomatoes.	Cabbage.	Rape.
	Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Acid phosphate	34.2	19.8	9.6	11.5	38.3	29 3
Florida rock (floats)	8.8	12.5	4.8	......	46	28.1
Thomas slag	21.1	15.9	8.1	8.4	45.8	10.9
Redonda phosphate	18.6	13.8	8.3	7.6	20	17.1
Bone meal	10.3	10.5	6.4	.9	41.3	32.1
No phosphoric acid	6.8	7.7	2.6	......	....	....
No fertilizer	4.9	3.7	2.0	......	....	....

TABLE VIII.—PHOSPHORIC ACID AVAILABILITY EXPERIMENTS: QUANTITIES OF P_2O_5 UTILIZED, 1898-9.

	Barley.	Millet.	Oats.	Clover.	Vetch.	Tomatoes.	Cabbage.	Rape.
	Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Acid phosphate	.687	.194	.473	.209	.215	.224	.417	.218
Florida rock (floats)	.011	.004	.007	.002	.052	.004	.216	.209
Thomas slag	.379	.051	.308	.143	.153	.136	.371	.452
Redonda phosphate (dehydrated)	.319	.082	.243	.083	.104	.153	.255	.228
No phosphoric acid	.008	.003	.005	.001	.002	.....	....	.....
No fertilizer	.011	.003	.011	.002	.002	.....	.004	.004

TABLE IX.—PHOSPHORIC ACID AVAILABILITY EXPERIMENTS: QUANTITIES OF P_2O_5 UTILIZED, 1899-1900.

	Barley.	Peas.	Vetch.	Tomatoes.	Cabbage.	Rape.
	Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Acid phosphate	.132	.156	.063	.098	.204	.139
Florida rock (floats)	.010	.038	.008	......	.168	.082
Thomas slag	.044	.060	.021	.031	.225	.056
Redonda phosphate	.038	.038	.029	.032	.111	.075
Bone meal	.013	.029	.018	.002	.192	.143
No phosphoric acid	.009	.016	.004	......	......	....
No fertilizer	.010	.007	.004	......	......	....

There is no uncertainty about the conclusions to which the above data point. The main fact shown is that under the conditions involved the availability of a phosphate is quite as much a matter of the kind of crop as of the form of combination of the phosphoric acid. The three crops belonging to the grass family — barley, millet and oats, grew luxuriantly in the acid phosphate boxes but acquired insignificant amounts of phosphoric acid, and made little growth, where the undissolved Florida rock was used. In strong contrast to this are the results with cabbage and rape (cruciferous plants) where the growth of dry matter from the floats was in some cases as large as with the acid phosphate and in no instance noticeably less than three-fourths as large. The cruciferous plants absorbed phosphoric acid from the floats in fairly generous quantities but not as much in proportion to the growth of dry matter as from the acid phosphate. The Thomas slag and Redonda phosphate appeared to be quite available to all crops, although the growth from those was, with a single exception, less with all species and in all the experiments than from the acid phosphate.

The striking and important fact developed by these experiments, however, is the unlike capacity of different species of plants to utilize a given source of plant food, or, to put the matter another way, the unlike adaptability of a given soil environment to meeting the needs of different species of plants. It is fundamental in all our reasoning about plant nutrition to understand whether plants possess with different degrees of intensity what may be called feeding power, or whether it is merely a question of securing for a particular species what may be termed a "sympathetic" soil environment. It is quite clear that plants possess more or less selective power in taking up the chemically available compounds with which the roots are in contact, and why may not there exist differences in their reaction upon a given compound in the way of preparation for absorption?

It is certain that in these and previous experiments a given compound is inert to one plant to a much greater degree than to

another. It should be remembered that the soluble salts, which one would expect to be the main factor in modifying the chemical status of the soil, were practically alike, added in practically the same forms and in the same quantities with all the forms of phosphoric acid and it seems hardly possible that a minute proportion of the insoluble phosphates which are very slow to react, would of itself so modify root environment as to cause the observed differences in growth, not caused by differences in the supply of available material. The most rational theory for explaining the foregoing data is that the roots of the various species of plants do not react alike upon soil compounds. This conclusion should not be regarded as condemning the use of insoluble phosphates under all conditions. This line of inquiry is directed toward the discriminating use of such materials.

INFLUENCE OF FINENESS UPON THE AVAILABILITY OF RAW GROUND PHOSPHATES.

During recent years there has been much discussion concerning the usefulness of ground raw phosphatic rock as a fertilizer. In this connection the influence of fineness upon the availability of the phosphoric acid in this material is an important consideration.

Box experiments carried on in 1899–1900 and 1903–4 with undissolved Florida rock ground to different degrees of fineness have yielded interesting results which are worthy of permanent record.

PLAN OF EXPERIMENTS.

The experimental plants were grown in the forcing house in wooden boxes 15″ x 15″. In 1899–1900 the soil consisted of quartz sand as follows: 46 lbs. of sand passed through a sieve forty meshes to the inch, 8 lbs. of medium coarse and 4 lbs. of coarse for drainage. In 1903–'4 the soil was also quartz sand consisting of 31 lbs. of fine, 4 lbs. of medium, and 8 lbs. of coarse for drainage; to the fine sand was added .93 lb. or 3 per ct. of ground sphagnum moss. The moss was that which had grown

under water, and previous to using, it was air dried, freed from sticks and then coarsely ground.

All the boxes except the blanks were supplied with the necessary forms of plant food, the phosphorus as acid phosphate or as raw ground Florida rock varying in fineness from that passing through a sieve 60 meshes to the inch to "floats." The following tables show the kinds and quantities of fertilizing materials applied. The chemicals used were Kahlbaums C. P.

TABLE X.—PHOSPHORIC ACID FINENESS EXPERIMENTS: FERTILIZER INGREDIENTS USED, 1899–1900.

	Amount per box.						
	P_2O_5	K_2O	N	$MgSO_4+7H_2O$	Fe_2Cl_6	$CaSO_4+2H_2O$	$CaCO_3$
	Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Acid phosphate	*3	*5	*2.5	*2.5	*1.0	.....	10.2
Florida rock, 60	"	"	"	"	"	†6.33	5.9
" " 80	"	"	"	"	"	"	"
" " 100	"	"	"	"	"	"	"
" " B. C.	"	"	"	"	"	"	"
" " fine	"	"	"	"	"	"	"
" " floats	"	"	"	"	"	"	"
Bone meal, 60	"	"	"	"	"	"	6.0
" " 80	"	"	"	"	"	"	"
" " 100	"	"	"	"	"	"	"
" " B. C.	"	"	"	"	"	"	"
" " fine	"	"	"	"	"	"	"
Blanks	"	"	"	"	"	"	"

* Added to all boxes.
† Added to all boxes but the one receiving acid phosphate.

It is to be noted that hydrated calcium sulphate was added to all the boxes except those receiving acid phosphate in order that conditions might be entirely alike excepting as to the form of the phosphorus compound. Calcium carbonate was also supplied to all boxes as a means of securing and maintaining the necessary basic condition in an artificial soil of this character.

The crops used in the experiments of 1899–1900 were barley, crimson clover, peas and rape.

The results were such that only those with barley and rape seem to be worth reporting, Three successive crops of rape were

TABLE XI.—PHOSPHORIC ACID FINENESS EXPERIMENTS: FERTILIZER INGREDIENTS USED, 1903–4.

	Composition.					Amounts used in each box.						
		Total available.										
	P_2O_5	P_2O_5	K_2O	N		$MgSO_4 + 7H_2O$	Fe_2Cl_6	$CaSO_4 + H_2O$	$CaCo_3$	P_2O_5	K_2O	N
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
Acid phosphate	......	25.2	......	......	5.96	1.94	1.00	......	7.91	1.5	2.5	*1.5
Sodium nitrate	......	......	......	16.3	9.2	......	......	......	......	......	......	......
Potassium sulphate	......	......	53.7	......	4.65	......	......	......	......	......	......	......
Florida rock, 60	31.3	......	......	......	4.8	1.94	1.00	3.46	5.98	1.5	2.5	1.5
" " 80	31.6	......	......	......	4.74	"	"	"	"	"	"	"
" " 100	31.5	......	......	......	4.77	"	"	"	"	"	"	"
" " †B. C.	31.8	......	......	......	4.71	"	"	"	"	"	"	"
" " fine	32.6	......	......	......	4.60	"	"	"	"	"	"	"
" " floats	33.4	......	......	......	4.49	"	"	"	"	"	"	"
Bone meal, 60	25.5	......	......	......	5.88	"	"	"	5.56	"	"	"
" " 80	25.9	......	......	......	5.79	"	"	"	"	"	"	"
" " 100	25.8	......	......	......	5.80	"	"	"	"	"	"	"
" " B. C.	26	......	......	......	5.76	"	"	"	"	"	"	"
" " finest	24.8	......	......	......	6.04	"	"	"	"	"	"	"

* The amount added to all boxes at first, 1.625 grams added later to all crops.
† B. C. = bolting cloth.

TABLE XII.— EFFECT OF THE DEGREE OF FINENESS UPON THE AVAILABILITY OF AN INSOLUBLE PHOSPHATE, 1899–1900.

	Rape, 1st crop.			Rape, 2nd crop.			Rape, 3d crop.			Total P_2O_5 used 3 crops of rape.	Barley. Dry matter produced.
	Yield dry matter.	P_2O_5 used.	P_2O_5 per gram dry matter.	Yield dry matter.	P_2O_5 used.	P_2O_5 per gram dry matter.	Yield dry matter.	P_2O_5 used.	P_2O_5 per gram dry matter.		
	Grams.	*Mgr.*	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*	*Mgr.*	*Grams.*
Acid phosphate	72.3	392.5	5.4	49.3	280	9.7	26.2	140.5	5.4	813	66.4
Florida rock 60	47.5	124.5	2.4	30.9	128.5	4.1	25	105	4.2	358	7.6
" " 80	36.5	84	2.1	30.1	124.5	4.1	27.6	94.5	3.4	303	9
" " 100	37.6	85.5	2.1	28.5	133.5	4.7	29.3	106.5	3.6	325.5	6.8
" " B. C	46.3	109	2.2	28.4	108	4.1	29.4	90	3.1	307	7.8
" " fine	45.2	114	2.3	34	123.5	3.7	31.3	109.5	3.5	347	7.3
" " floats	52.8	137	2.4	35.6	145.5	4.1	32.4	117.5	3.6	400	11.1
Bone meal, 60	54.8	194.5	3.5	36.9	191	4.9	32.7	188	5.7	573.5	9.8
" " 80	53	208.5	3.9	35.9	179	5	33	160	4.9	547.5	7.3
" " 100	54.5	218.5	4	40.1	205	5.1	32.7	153.5	4.7	577	6.9
" " B. C	60.9	247.5	4	35.1	187	5.3	36	158.5	4.4	593	6.9
" " fine	49.2	211	4.3	39.4	248	6.3	26.7	131.5	4.9	591.5	9.5

TABLE XIII.— EFFECT OF DEGREE OF FINENESS UPON THE AVAILABILITY OF AN INSOLUBLE PHOSPHATE, 1903–4.

Condition of phosphate used	Peas, 1903–4.			Barley, 1903–4.			Rape, 1903–4.		
	Yield dry matter.	P_2O_5 used.	P_2O_5 per gram dry matter.	Yield dry matter.	P_2O_5 used.	P_2O_5 per gram dry matter.	Yield dry matter.	P_2O_5 used.	P_2O_5 per gram dry matter.
	Grams.	*Mgr.*	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*
Blanks	8.4	39	4.6	12.2	40	3.3	....	....	....
Acid phosphate	69.9	633.5	9.0	166.7	538.5	3.2	48	549	11.4
Florida rock, 60	64.1	321	5	140	268.5	1.9	54.5	327.5	6
" " 80	63.1	336.5	5.3	165.7	352	2.1	58.2	383	6.6
" " 100	62.8	360.5	5.7	176.3	460	2.6	56.3	396.5	7
Bolting cloth	60.3	329.5	5.4	164.4	402.5	2.4	58.7	439	7.5
" " fine	67.5	420.5	6.2	172.9	417.5	2.4	58.8	499.5	8.5
" " floats	68	524.5	7.7	162.7	471.5	2.9	57.7	522	9.0
Bone meal, 60	59.8	557.5	9.3	160	480	4	46.5	545	11.7
" " 80	60.4	578.5	9.6	168.7	546.5	3.2	46.8	591	12.6
" " 100	627	579	9.2	175.3	613.5	3.5	40.7	534	13.1
Bolting cloth	61.6	623	10.1	164.6	544.5	3.3	44.8	574	12.8
" " fine	59.6	597.5	10	177	544	3.1	48.6	601	12.4

grown in the same boxes without renewal of the supply of phosphates for the second and third crops. In 1903–4 with a more favorable and efficient artificial soil, due to the introduction of sphagnum moss, the experiments were much more successful. The crops used were barley, peas and rape.

In all cases the plants were allowed to attain the fullest development that seemed to be possible under the conditions involved, which in the case of barley, peas and rape was quite satisfactory.

The preceding tables show the yield of dry matter, the quantities of P_2O_5 taken up from the acid phosphate and from the raw phosphate of the different degrees of fineness, and the relation in quantity of the P_2O_5 used to the dry matter produced. In the case of the barley in 1899–1900 the yield was so small, excepting with the acid phosphate, that the content of P_2O_5 in the crop was not determined.

Certain facts revealed in the above figures are worthy of comment.

The results as a whole clearly show that fineness of division has an important influence upon the availability of raw ground phosphate rock. This does not appear in any striking way with the rape of 1899–1900, but in the second season's tests (1903–4), with all three crops used, the P_2O_5 assimilated increases quite uniformly with the degree of fineness. In the case of bone, fineness seemed to have small influence on availability, at least within the limits tested.

The fineness of the ground rock and bone had small influence on the growth of dry matter in the various crops. The plants seem to have secured enough phosphoric acid from even the coarsest materials to satisfy the demands of the maximum growth possible under the conditions established. This means that the proportion of phosphoric acid to dry matter increased with the fineness of division of the ground rock. The amount of phosphoric acid assimilated from the acid phosphate was notably greater than what was appropriated from the undissolved rock, even though the growth of dry matter was but little, if any, larger.

It appears that there is no fixed relation between the dry matter and the mineral elements of a plant, but that the use of these elements for a unit of growth is within a certain limit proportional to the available supply. This point is more fully dealt with in experiments that will be described later.

THE FERTILIZING VALUE OF AN IRON ORE WASTE.

During the year 1908, there was called to the attention of the writer a by-product, which is designated here as Iron Ore Waste, supposed to be valuable because of the presence of a considerable percentage of phosphoric acid. This phosphoric acid is doubtless in combination as apatite, although no mineralogical examination was possible by us because the material was sent to us in a finely ground condition. As this seemed to be a matter of considerable economic importance and as no experiments seemed to have been made with this by-product, tests of its availability, as compared with other phosphates, were made in one of the forcing houses of the Station. The following table gives the results of this experimental work. The artificial soil used was similar to that given on pages 22 and 23 of this bulletin. The experimental crop was barley.

TABLE XIV.—TEST OF THE COMPARATIVE AVAILABILITY TO BARLEY OF THE PHOSPHORIC ACID CONTAINED IN IRON ORE WASTE.

Source of the Phosphoric Acid.	Supply.			Production of Barley.			Availability by Chemical Methods.	
	Material.	Total P_2O_5	Amount P_2O_5 applied.	Fresh crop.	Dry substance.	Average dry substance.	Wagner method.	Official method.*
	Grams.	*Per ct.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Per ct.*	*Per ct.*
Mono-calcic-phosphate...	10.02	58.04	5.817	120	71	....	58.04	58.04
	10.02	58.04	5.817	122	71	71	....	....
Iron ore waste..........	37.65	15.45	5.817	62	48.5	....	.52	.31
	37.65	15.45	5.817	59.5	40	44.2	....	....
Basic slag.............	30.18	19.27	5.817	117.5	77	....	16.99	8.25
	30.18	19.27	5.817	94	60.5	68.7	....	....
Ground Tennessee rock...	22.21	26.19	5.817	96.5	57	....	5.61	.76
	22.21	26.19	5.817	89	54.5	55.7	....	....
Bone..................	26.04	22.34	5.817	94	72.5	....	19.48	6.62
	26.04	22.34	5.817	104	77	74.7	....	....
Blanks................	......	......	....	71.5	37.5	....	....	....
Blanks................	......	......	....	69	39	38.2	....	....

* Method adopted by the Association of Official Agricultural Chemists.

The above figures show clearly that the phosphoric acid in the iron ore waste had little availability. Moreover, the results corroborate those previously given as to the inability of graminaceous plants to utilize freely the ground untreated phosphates, such as Tennessee rock.

These tests, with some preliminary analyses, present some interesting data regarding the chemical methods for determining available phosphoric acid. In planning the tests, it became necessary to know the amounts of total P_2O_5 in the different materials in order to apply equal amounts in the different boxes. These determinations were made by A. W. Clark, Assistant Chemist; and he also analyzed the samples for available P_2O_5 by both the official method and the Wagner method. These results are shown in the last two columns of Table XIV. The official method gave little P_2O_5 in either the iron ore waste or the ground rock, yet the barley made some growth on both. Rather hasty scrutiny showed that the results by the Wagner method approached nearer to the measure of utilization of phosphorus by the barley; and computations gave the data shown in Table XV.

TABLE XV.—RELATIVE AVAILABILITY OF PHOSPHORIC ACID FROM DIFFERENT SOURCES AS MEASURED BY CHEMICAL METHODS OR SHOWN BY PLANT PRODUCTION.

Monocalcium phosphate taken as base.

METHOD OF DETERMINING AVAILABILITY.	AVAILABLE PHOSPHORIC ACID IN —									
	MONO-CALCIUM PHOSPHATE.		IRON ORE WASTE.		BASIC SLAG		GROUND TENNESSEE ROCK.		BONE.	
	Amt.	Proportion.*	Amt.	Proportion.*	Amt.	Proportion.*	Amt.	Proportion.*	Amt.	Proportion.*
	Grams.	*Per ct.*	*Grams.*	*Per ct.*	*Grams.*	*Per ct.*	*Grams.*	*Per ct.*	*Grams.*	*Per ct.*
Official	5.82	100	.117	2.0	2.49	42.8	.168	2.9	1.72	29.5
Wagner	5.82	100	.195	3.3	5.13	88.1	1.25	21.5	5.07	87.1
	DRY MATTER PRODUCED BY BARLEY, LESS AMOUNT ON CHECKS.									
Plant production	32.8	100	6.0	18.3	30.5	93.0	17.5	53.3	36.5	111.3

* The relation, expressed as percentage, which the amount of available phosphoric acid in these boxes bears to that in the corresponding mono-calcium phosphate boxes.

The increase of plant production was found by subtracting the weight of dry matter produced on the check boxes from that

produced on the other boxes, this increase being presumably due to the phosphoric acid utilized. It will be observed that in each case the percentage increase of dry matter, using the mono-calcium phosphate boxes as a basis, is greater than the relative percentage of available $P_2 O_5$ as shown by the Wagner method and much greater than that shown by the official method.

STUDIES IN PLANT NUTRITION. II.*

W. H. JORDAN.

SUMMARY.

1. Experiments were conducted in a Station forcing house during the years 1900–1, 1901–2 and 1903–4 with a view to ascertaining what is the essential minimum amount of phosphoric acid and potash which must be available to plants in order that maximum growth may be secured.

2. In one set of boxes the basal ration supplied all needed elements save phosphoric acid, this being added in progressive quantities to the several boxes. In the other set of boxes, the basal ration supplied all the necessary elements save potash, which was added in progressive quantities to the several boxes.

3. The experimental plants included barley, peas, tomatoes, tobacco, buckwheat, rape, and turnips.

4. The growth of the plants was, in most instances, such as would be satisfactory with field-grown crops, the production of dry matter with barley being in two of the three experiments beyond what could reasonably be expected in a farm crop.

5. Up to a somewhat indefinite point, the production of plant substance increased with the increase in the supply of the variable constituents, but beyond this point the utilization of both phosphorus and potassium compounds increased without any consistent and well defined corresponding increase of the plant growth.

6. The data secured do not permit the establishment of any definite minimum relation between the intake of phosphorus and potassium and the dry matter produced.

7. The results secured indicate that what a given crop contains of certain elements is not necessarily to be regarded as a measure of what must be supplied in order to meet the needs for maximum growth.

THE NECESSARY SUPPLY OF PLANT FOOD.

INTRODUCTION.

The question is often asked by farmers concerning the production of a particular crop, "How much nitrogen, phosphoric acid and potash does it (the crop) remove from the soil?" The assumption in this question evidently is that what a plant uses in growth represents its needs, and indicates what should be supplied either from the soil or in a fertilizer.

Such an assumption can hardly be considered sound. It is well known that some plants, tobacco for instance, grow with equal

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luxuriance even when the ingredients of the ash differ in quantity and proportions to a marked degree.

Students of plant nutrition cannot fail to observe that the composition of the ash of the same species of plant varies greatly according to the locality in which the plant is grown and the methods used.

In view of these facts it is proper to inquire whether there is a determinable minimum proportion of certain ingredients in the dry matter produced by agricultural plants. In other words, what is the essential minimum of phosphoric acid or potash which must be available to a plant in order that maximum growth may be secured?

An attempt has been made to throw light on this question by carefully controlled experiments in which several species of plants were grown under such conditions that all the needed elements of plant growth but one were available in great abundance, this one element being supplied to different lots of plants in progressively increasing quantities. Such experiments were continued during three seasons.

PLAN AND DETAILS OF EXPERIMENTS.

The experiments in question were carried on in the Station forcing houses during the winters of 1900–1, 1901–2 and 1903–4. The experimental plants included barley, peas, tobacco, tomatoes, buckwheat, rape, and turnips. These were grown in boxes fifteen inches square and six inches deep, which were filled as follows:

1900–1	Quartz sand and coarse quartz for drainage weighing in all about.....	50 pounds.
1901–2	Quartz sand running through sieve forty meshes to the inch..........	31 pounds.
	Fine drainage......................	4
	Coarse drainage....................	8
	Ground sphagnum moss............	.93 pounds.
1903–4	Filling the same as in 1901–2.	

The moss used, which constituted about 3 per ct. of the mixture, was that which had grown under water. It was air dried, sticks and foreign matter were removed, and then it was coarsely ground. On analysis it was found to contain .0984 per ct. of potash (K_2O). Of P_2O_5 there was present only a trace.

As a source of plant food Kahlbaums c.p. chemicals were used, including the tri-calcium phosphate from which the acid phosphate was made.

The experimental boxes included two general series, those in which graduated amounts of phosphoric acid were used, and those in which the same plan was followed with potash.

The basal supply of chemicals was as follows, the quantities given being added to the soil of each box at the time the boxes were filled:

TABLE I.—BASAL SUPPLY OF CHEMICALS IN PLANT-FOOD REQUIREMENT EXPERIMENTS.

EXPERIMENTS WITH P_2O_5.

	1900–1.	1901–2.	1903–4.
	Grams.	*Grams.*	*Grams.*
Potassium sulphate	4.660	4.660	3.723
Containing K_2O	2.50	2.5	2.000
Sodium nitrate	7.594	7.594	9.196
Containing N	1.25	1.250	1.500
Magnesium sulphate	1.000	1.000	1.940
Ferric chloride	.750	1.000	1.000
Calcium carbonate	10.000	10.774	7.909

EXPERIMENTS WITH K_2O.

	1900–1.	1901–2.	1903–4.
	Grams.	*Grams.*	*Grams.*
Acid phosphate	12.712	7.933	5.957
(Containing P_2O_5)	3.	2.	1.500
Sodium nitrate	7.594	7.594	9.196
(Containing N)	1.25	1.250	1.500
Magnesium sulphate	1.000	1.000	1.940
Ferric chloride	.750	1.000	1.000
Calcium carbonate	10.000	10.774	7.909

In 1900–1 all the nitrogen was mixed with the artificial soil at the time the boxes were filled, but in 1901–2 and 1903–4 only part of the sodium nitrate was added at first, the remaining portion being applied in dilute solution at intervals during the growth of the plants. The total quantities of nitrogen used per box were as follows:

TABLE II.— NITROGEN SUPPLY IN PLANT-FOOD REQUIREMENT EXPERIMENTS.

	TOTAL AMOUNT NITROGEN TO EACH BOX.	
	1901–2.	1903–4.
	Grams.	*Grams.*
Barley	4	3.125
Buckwheat	2.50	......
Peas	4	......
Rape	3.50	3.125
Tobacco	4	3.125
Tomatoes	3.50	3.750

The graduated quantities of P_2O_5 and K_2O that were applied to individual boxes in the several experiments had the following range:

TABLE III.—RANGE IN AMOUNT OF P_2O_5 AND K_2O IN PLANT-FOOD REQUIREMENT EXPERIMENTS.

Amounts of P_2O_5 and K_2O in Individual Boxes.					
1900–1.		1901–2.		1903–4.	
P_2O_5.	K_2O.	P_2O_5.	K_2O.	P_2O_5.	K_2O.
Mgr.	*Mgr.*	*Mgr.*	*Mgr.*	*Mgr.*	*Mgr.*
50	100	150	100	50	100
100	200	300	200	100	400
150	400	450	300	200	700
200	600	600	500	200	1,000
250	800	750	750	400	1,200
300	1,000	900	1,000	500	1,600
400	1,500	1,050	1,250	600	1,900
500	2,000	1,200	1,500	700	2,200
750	3,000	1,350	2,000	800	2,500
1,500	4,000	1,500	3,000	1,000	2,700

For convenience of reference the above figures are repeated in connection with the statement of results.

As stated, the crops were grown in one of the Station forcing houses. Distilled water, free from mineral compounds, was applied to the various soils, thus holding the food supplied to the plants to the quantities contained in chemicals and other materials used.

RESULTS OF EXPERIMENTS.

So far as possible, the various crops were allowed to attain maturity before they were harvested. With the exception of 1900–1 the production was in general as large as would be secured under field conditions.

After careful air drying, the entire product of each box was preserved for analysis.

Crop production.— The following are the yields of fresh and air-dry material with each box under the various methods of treatment.

TABLE IV.— CROP PRODUCTION IN PLANT-FOOD REQUIREMENT EXPERIMENTS: P_2O_5 VARYING IN AMOUNT, OTHER ELEMENTS IN FULL SUPPLY.

1900–1.			1901–2.			1903–4.		
P_2O_5 supplied.	Yield fresh crop.	Yield air-dry matter.	P_2O_5 supplied.	Yield fresh crop.	Yield air-dry matter.	P_2O_5 supplied.	Yield fresh crop.	Yield air-dry matter.
			BARLEY.					
Mgr.	*Grams.*	*Grams.*	*Mgr.*	*Grams.*	*Grams.*	*Mgr.*	*Grams.*	*Grams.*
Blank	16.5	7.5	Blank	27	15.5	......	......	......
None	17	6.5	None	163	63.5	None	76	36
1,050	35.5	13.5	150	268	104.5	50	113	50
100	69.3	25.8	300	326	136	100	147	66
150	81.7	32.2	450	354.5	138	200	215	93
200	98.5	40	600	332.5	145	300	260	115
250	108.9	45.4	750	328.5	148.5	400	295	136
300	109	45.5	900	403.5	179.5	500	335	145
400	118	48	1,050	395	169.5	600	343	153
500	118	49.5	1,200	329	163	700	351	166
750	117	49	1,350	386.5	159	800	345	155
1,500	115.8	49.8	1,500	407	192	1,000	361	159
None	18	7.5	None	163	62.5	None	75	34
50	40.5	15	150	310	109	50	111	48
100	55.8	21.3	300	378.5	134	100	145	64
150	96	36	450	415.5	165.5	200	222	95
200	102.3	38.3	600	381	153	300	274	117
250	108	43	750	401	159	400	305	135
300	107	43.5	900	367	163	500	319	147
400	113.3	43.8	1,050	424.5	168	600	324	144
500	113.5	44.5	1,200	470.5	175	700	347	149
750	107.5	45	1,350	469	185.5	800	357	155
1,500	108	45.5	1,500	460	197.5	1,000	383	160
			PEAS.					
Blank	19	4.2	Blank	74	12.5	......	......	......
None	47	8.5	None	198	34.5	None	64	9
50	40	7.5	150	177	30	50	129	24
100	54	10	300	306	49	100	186	40.5
150	55	10	450	364.5	56	200	342	64
200	50.5	9.5	600	281	44	300	403	73
250	56.8	10.8	750	313.5	48	400	423	76
300	57	11.3	900	300	48	500	483	85.5
400	42.8	8.8	1,050	324.5	52.5	600	456	76.5
500	35	8	1,200	336	52	700	447	83
750	35	9	1,350	330	53.5	800	473	81
1,500	60	14	1,500	432.5	71	1,000	412	75
None	......	......	None	132.5	22.5	None	60	9
50	......	......	150	233	39	50	118	26.5
100	......	......	300	324	49	100	187	36
150	......	......	450	327	49	200	305	58
200	......	......	600	230.5	36	300	364	62.5
250	......	......	750	267.5	43	400	358	59
300	......	......	900	338.5	52.5	500	423	70.5
400	......	......	1,050	286.5	44.5	600	346	63
500	......	......	1,200	313	49.5	700	425	73.5
750	......	......	1,350	338.5	67.5	800	479	80.5
1,500	......	......	1,500	338.5	54.5	1,000	441	77.5

TABLE IV (*continued*).

TOBACCO.								
1900–1.			1901–2.			1903–4.		
P_2O_5 supplied.	Yield fresh crop.	Yield air-dry matter.	P_2O_5 supplied.	Yield fresh crop.	Yield air-dry matter.	P_2O_5 supplied.	Yield fresh crop.	Yield air-dry matter.
Mgr.	*Grams.*	*Grams.*	*Mgr.*	*Grams.*	*Grams.*	*Mgr.*	*Grams.*	*Grams.*
Blank	......	.01	Blank	93.5	16.5	......	......	....
None	......	.05	None	185.5	40.5	None	25	3.5
50	......	.15	150	300.5	74.5	50	118	19
100	......	2	300	416	78	100	162	31
150	......	4.5	450	458.5	77	200	281	40
200	......	5.5	600	443	81.5	300	297	46
250	......	11.5	750	410.5	75	400	349	48
300	......	18	900	476	80.5	500	359	48
400	......	22	1,050	465	71	600	370	53
500	......	25	1,200	488	76.5	700	327	48
750	......	26.5	1,350	475.5	70.5	800	337	49
1,500	......	24.5	1,500	449	69	1,000	324	51
None	......	.01	None	194	43	None	42	6
50	......	.08	150	304	64.5	50	101	15
100	......	.47	300	348.5	68	100	166	31
150	......	5.50	450	428	74.5	200	303	43
200	......	4	600	478	68.5	300	311	48
250	......	8	750	455	70.5	400	296	47
300	......	12.5	900	482	69	500	340	51
400	......	19.5	1,050	422.5	63	600	308	51
500	......	24	1,200	397.5	74	700	271	45
750	......	24	1,350	422	70.5	800	343	48
1,500	......	20	1,500	373	72	1,000	366	48

TURNIPS.			TOMATOES.					
1900–1.			1901–2.			1903–4.		
P_2O_5 supplied.	Yield fresh crop.	Yield air-dry crop.	P_2O_5 supplied.	Yield fresh crop.	Yield air-dry crop.	P_2O_5 supplied.	Yield fresh crop.	Yield air-dry crop.
Mgr.	*Grams.*	*Grams.*	*Mgr.*	*Grams.*	*Grams.*	*Mgr.*	*Grams.*	*Grams.*
Blank	11.1	2	Blank	75.5	12.5	......	......	....
None	3	1	None	292.5	40.5	None	3.5	.44
50	25.3	4.7	150	469.5	62	50	150	17
100	41.1	7	300	555	73	100	255	29.5
150	74.6	13.7	450	512	68	200	356	39.5
200	60.3	13	600	555.7	80.5	300	393	47.5
250	84.4	17	750	500	75	400	281	50
300	68.2	15.8	900	647	77	500	465	57
400	89.3	17	1,050	560.5	69	600	469	60
500	92.8	20	1,200	633.5	76	700	516	58
750	85	17.5	1,350	643.5	79	800	472	57
1,500	85.3	20	1,500	473.5	68	1,000	446	56.5
None	2.3	1	None	354.5	43	None	.91	.16
50	15.9	3	150	434.5	64	50	124	17
100	48.1	8.3	300	431	65	100	206.5	23.5
150	73.7	13.5	450	496	76	200	293	37.5
200	54.7	12	600	460	79	300	287	43.5
250	83.5	16.5	750	644	93.5	400	463	60
300	57.4	12.7	900	605	82	500	428	51
400	90	17.7	1,050	575	78	600	467	60
500	83.9	18	1,200	626	84.5	700	487	56.5
750	72.9	15	1,350	637.5	80.5	800	411	52
1,500	73.1	16.5	1,500	523	75.5	1,000	467	59

TABLE IV (*concluded*).

BUCKWHEAT.			RAPE.		
1901-2.			1901-2.		
P_2O_5 supplied.	Yield fresh crop.	Yield air-dry matter.	P_2O_5 supplied.	Yield fresh crop.	Yield air-dry matter.
Mgr.	*Grams.*	*Grams.*	*Mgr.*	*Grams.*	*Grams.*
Blank	30.5	5.5	Blank	26.5	5.5
None	73.5	14	None	185.5	33
150	73	13	150	303	48.5
300	76.5	16	300	345	54
450	76	15	450	390	59
600	77	13	600	384.5	58.5
750	69	10.5	750	386.5	57
900	76.5	12	900	412.5	60.5
1,050	80.5	12	1,050	387	58
1,200	70.5	10.5	1,200	385.5	56.5
1,350	71.5	11	1,350	414.5	57
1,500	74	11.5	1,500	425	62
None	71	13.5	None	171	31.5
150	86	16.5	150	303	49.5
300	68.5	12.5	300	360.5	52
450	87.5	16	450	443	57.5
600	80.5	14	600	457.5	61
750	85	15.5	750	426.5	59.5
900	79	12.5	900	410.5	56
1,050	89.5	14.5	1,050	379	55
1,200	70.5	11.5	1,200	393.5	56
1,350	71.5	11	1,350	359	64.5
1,500	82.5	12.5	1,500	405.5	63

TABLE V.— CROP PRODUCTION IN PLANT-FOOD REQUIREMENT EXPERIMENTS: K_2O VARYING IN AMOUNT, OTHER ELEMENTS IN FULL SUPPLY.

BARLEY.								
1900-1.			1901-2.			1903-4.		
K_2O supplied.	Yield fresh crop.	Yield air-dry matter.	K_2O supplied.	Yield fresh crop.	Yield air-dry matter.	K_2O supplied.	Yield fresh crop.	Yield air-dry matter.
Mgr.	*Grams.*	*Grams.*	*Mgr.*	*Grams.*	*Grams.*	*Mgr.*	*Grams.*	*Grams.*
Blank	11	6	Blank	50	32	......	52	23
None	42.3	20.5	None	275	145	......	......	......
100	58.7	28	100	288.5	140	100	239	119
200	83.4	37	200	329	147.5	400	292	139
400	104.5	47.7	300	323	140	700	310	153
600	127.2	59	500	368	167	1,000	336.5	160
800	118.5	54.5	750	382.5	171	1,300	346	163
1,000	129.7	55.5	1,000	358	153	1,600	347	163
1,500	146.8	62.5	1,250	384	176	1,900	361	169
2,000	148	62	1,500	418	181	2,200	348	162
3,000	157.2	64.5	2,000	377	183	2,500	363	170
4,000	136.8	59	3,000	409	191	2,700	356	173
None	24.7	14.5	None	264.5	132.5	......	30	15
100	32.6	18	100	354.5	154.5	100	241	115
200	51.3	29.5	200	374.5	163.5	400	279	138
400	78.7	40.5	300	341	151.5	700	288	133
600	110.5	49.5	500	372	168.5	1,000	320	154
800	98.4	48.5	750	394	163	1,300	287	142
1,000	112.7	51	1,000	382.5	164.5	1,600	332	156
1,500	125.5	58.5	1,250	377	161.5	1,900	313	147
2,000	122.2	56.2	1,500	389	169.5	2,200	328	160
3,000	141.5	60	2,000	450.5	191.5	2,500	320	153
4,000	146.7	61	3,000	444	208	2,700	357	171

TABLE V (*continued*).

1900–1.			1901–2.			1903–4.		
K_2O supplied.	Yield fresh crop.	Yield air-dry matter.	K_2O supplied.	Yield fresh crop.	Yield air-dry matter.	K_2O supplied.	Yield fresh crop.	Yield air-dry matter.
				PEAS.				
Mgr.	*Grams.*	*Grams.*	*Mgr.*	*Grams.*	*Grams.*	*Mgr.*	*Grams.*	*Grams.*
Blank	16	4	Blank	98.5	16.5	Blank	101	16
None	59	13	None	373.5	61.5	......	......	......
100	59	14	100	294.5	49	100	466	80
200	59	14.5	200	430	62	400	474	76
400	97	19	300	356	49	700	481	75
600	58	13.5	500	490.5	68.5	1,000	484	79
800	77	15.5	750	350	49.5	1,300	469	76
1,000	80	15.5	1,000	401.5	59.5	1,600	524	84
1,500	113	20.5	1,250	396.5	59.5	1,900	493	78
2,000	86	17	1,500	408	58.5	2,200	519	77
3,000	87	17.5	2,000	524	71.5	2,500	473	82
4,000	46	11.5	3,000	459	67	2,700	493	79
None	50	12	None	325	53.5	Blank	106	18
100	63	14	100	403	63.5	100	453	78
200	58	12.5	200	352	59	400	472	77
400	107	20.5	300	404	63	700	494	77
600	62	13	500	382	57.5	1,000	514	75
800	67	14	750	324.5	49	1,300	471	83
1,000	84	16.2	1,000	385	59	1,600	503	75
1,500	95	19	1,250	334	51.5	1,900	523	82
2,000	91	17.5	1,500	337.5	53	2,200	532	81
3,000	78	16.7	2,000	411	61.5	2,500	390	57
4,000	39	12	3,000	290	46	2,700	510	80
				TOBACCO.				
Blank	......	.07	Blank	88.5	16	Blank	34	6
None	......	8	None	416.5	65.5	......	......	......
100	......	6.5	100	527	76.5	100	350	46
200	......	11	200	540	82.5	400	395	54
400	......	12	300	443	74	700	340	49
600	......	14	500	510.5	76	1,000	356	52
800	......	19	750	523	70.5	1,300	388	53
1,000	......	18.5	1,000	496.5	75	1,600	372	50
1,500	......	22	1,250	554.5	88	1,900	367	51
2,000	......	23.5	1,500	567	84.5	2,200	386	50
3,000	......	27.5	2,000	497	79.5	2,500	370	54
4,000	......	21.5	3,000	492.5	76	2,700	365	50
None	......	16.5	None	487.5	72	Blank	52	11
100	......	9.5	100	416	68.5	100	374	49
200	......	12.5	200	468	68.5	400	365	50
400	......	17	300	494.5	81.5	700	370	54
600	......	18.5	500	474	72.5	1,000	362	51
800	......	17	750	527.5	81	1,300	387	53
1,000	......	22	1,000	494	76	1,600	399	57
1,500	......	19.5	1,250	512	68	1,900	408	50
2,000	......	22.5	1,500	486	66.5	2,200	366	48
3,000	......	27	2,000	449.5	71	2,500	375	50
4,000	......	21.5	3,000	424.5	70	2,700	399	59

TABLE V (*concluded*).

TURNIPS.			TOMATOES.					
1900-1.			1901-2.			1903-4.		
K_2O supplied.	Yield fresh crop.	Yield air-dry matter.	K_2O supplied.	Yield fresh crop.	Yield air-dry matter.	K_2O supplied.	Yield fresh crop.	Yield air-dry matter.
Mgr.	*Grams.*	*Grams.*	*Mgr.*	*Grams.*	*Grams.*	*Mgr.*	*Grams.*	*Grams.*
Blank	......	.5	Blank	194.5	21	Blank	45	7
None	54	13.5	None	548.5	72	......	......	....
100	89	22.5	100	725.5	85.5	100	446.5	58
200	75.5	19	200	850	89	400	702	75
400	103	25	300	600	82.5	700	653	66
600	85.4	19.5	500	341	65.5	1,000	433	48
800	87	22	750	958.5	107	1,300	1,038	97
1,000	90.5	21	1,000	849.5	86.5	1,600	748	74
1,500	100.1	23	1,250	407.5	78	1,900	371.5	49
2,000	88.3	21	1,500	760	83.5	2,200	785	79
3,000	113.3	25	2,000	690	97	2,500	709	75
4,000	103.5	21.5	3,000	595	72	2,700	622.5	69
None	32	6.5	None	742	85.5	None	55	9
100	63.5	18.5	100	866	83	100	1,000.5	91
200	58.5	14	200	527.5	90	200	624	65
400	77.8	19	300	795	87.5	300	678	71
600	61.5	14	500	669.5	81	500	725.5	70
800	75	17	750	847.5	91	750	717	77
1,000	94	22.5	1,000	744	97	1,000	757.5	84
1,500	84.1	20	1,250	861.5	95	1,250	798	79
2,000	102.5	22.5	1,500	582	93	1,500	745	80
3,000	114.5	22	2,000	925	91	2,000	858	84
4,000	83.8	20	3,000	522.5	68.5	3,000	806.5	81

BUCKWHEAT.			RAPE.		
1901-2.			1901-2.		
K_2O supplied.	Yield fresh crop.	Yield air-dry matter.	K_2O supplied.	Yield fresh crop.	Yield air-dry matter.
Mgr.	*Grams.*	*Grams.*	*Mgr.*	*Grams.*	*Grams.*
Blank	58.5	14	Blank	27.5	4
None	82.5	17	None	463.5	63
100	87	18	100	496.5	63
200	88	18.5	200	568.5	71
300	83.5	17	300	522	63.5
500	108	20	500	641.5	72
750	104	21.5	750	444.5	59.5
1,000	98.5	22	1,000	500	67.5
1,250	92	17.5	1,250	481.5	62
1,500	103	18	1,500	595.5	69.5
2,000	125.5	24	2,000	535	63.5
3,000	110	20	3,000	538.5	65
None	63	14	None	484.5	62.5
100	72	15.5	100	529	65.5
200	82.5	18	200	608	68
300	95	20.5	300	574	67
500	103	21	500	543.5	64.5
750	105.5	21.5	750	576.5	63.5
1,000	104	22	1,000	530.5	67.5
1,250	94	18.5	1,250	536.5	67
1,500	111	21	1,500	522.5	67.5
2,000	112	21.5	2,000	465	61.5
3,000	106	22	3,000	478.5	71

Dry matter produced.— Determinations of dry matter, P_2O_5 and K_2O were made in the crops from each box and the tables which follow give the results of these analyses. The figures are the average of two boxes in most cases, and show the yields of dry matter, amounts of P_2O_5 or K_2O taken up and the quantities of dry matter produced for each milligram of P_2O_5 or K_2O taken up by the plants.

TABLE VI.— DRY SUBSTANCE PRODUCED IN PLANT-FOOD REQUIREMENT EXPERIMENTS: P_2O_5 IN VARYING AMOUNTS, OTHER ELEMENTS IN FULL SUPPLY.

BARLEY.

Amount of P_2O_5 applied per box.			1900-01.			1901-02.			1903-04.		
1900-01.	1901-02.	1903-04.	Yield dry matter.	P_2O_5 used.	P_2O_5 per gram dry matter.	Yield dry matter.	P_2O_5 used.	P_2O_5 per gram dry matter.	Yield dry matter.	P_2O_5 used.	P_2O_5 per gram dry matter.
Mgr.	*Mgr.*	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*
	Blanks.		7	5.6	.8	14.3	58	4.06	32.4	52.5	1.62
0	0	0	6.5	3.9	.6	57.9	57	1	......	......	......
50	150	.50	13.2	11.6	.88	97.8	124	1.26	45.6	119.9	2.60
100	300	100	21.7	17.9	.88	124.1	184	1.64	59.9	99.5	1.66
150	450	200	31.6	27.9	.88	142.6	268	1.88	86.5	179.1	2.03
200	600	300	36.4	37.6	1.03	136.8	293	2.14	117.6	207.9	1.96
250	750	400	40	56.1	1.40	140.5	360	2.6	124.8	247.1	1.98
300	900	500	41.4	59.4	1.43	156	396	2.54	134	264.4	1.97
400	1,050	600	42.4	66.2	1.56	153	444	2.90	137.3	284.6	2.07
500	1,200	700	43.5	76	1.75	154	530	3.44	145.1	373.8	1.88
750	1,350	800	43.7	73.5	1.68	157	560	3.56	143.5	391	2.72
1,500	1,500	1,000	44.1	101.9	2.3	178	632	3.55	147.2	394.8	2.7

PEAS.

Amount of P_2O_5 applied per box.			1900-01.			1901-02.			1903-04.		
1900-01.	1901-02.	1903-04.	Yield dry matter.	P_2O_5 used.	P_2O_5 per gram dry matter.	Yield dry matter.	P_2O_5 used.	P_2O_5 per gram dry matter.	Yield dry matter.	P_2O_5 used.	P_2O_5 per gram dry matter.
Mgr.	*Mgr.*	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*
	Blanks.		3.9	8.1	2.1	11.2	27	2.4	8.2	20.5	2.5
0	0	0	7.9	19.3	2.4	25.6	54.5	2.1	......	......	......
50	150	50	7	20	2.8	30.5	99.5	3.3	23	64.6	2.8
100	300	100	9.3	26.4	2.8	45.4	171.5	3.7	34.9	91.3	2.6
150	450	200	9.3	27.2	2.9	48.7	252.5	5.2	56.1	140	2.5
200	600	300	8.9	31.4	3.5	37.1	259	7	59.4	212.7	3.6
250	750	400	10.1	34.8	3.4	42	312	7.4	62	262.9	4.2
300	900	500	10.5	39.2	3.7	46.5	353.5	7.6	71.7	324.8	4.5
400	1,050	600	8.2	33	4	44.8	362.5	8.1	64	376.3	4.9
500	1,200	700	7.5	32.5	4.3	47	394	8.4	71.7	458.3	6.4
750	1,350	800	8.4	45.4	5.4	55.9	444	7.9	73.9	502.3	6.8
1,500	1,500	1,000	13.1	100.1	7.6	57.8	477.5	8.3	70.3	555.2	7.9

TABLE VI (*continued*).

TOBACCO.

Amount of P_2O_5 Applied Per Box.			1900-01.			1901-02.			1903-04.		
1900-01.	1901-02.	1903-04.	Yield dry matter.	P_2O_5 used.	P_2O_5 per gram dry matter.	Yield dry matter.	P_2O_5 used.	P_2O_5 per gram dry matter.	Yield dry matter.	P_2O_5 used.	P_2O_5 per gram dry matter.
Mgr.	*Mgr.*	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*
	Blanks.		....	....	....	15.5	34	2.2	5.5	11.9	2
0	0	0	....	....	....	38.9	65.5	1.7	....	....	....
50	150	50	....	....	....	64.3	148.5	2.3	15.6	33.4	2.1
100	300	100	1.9	4.1	2.1	68.1	200	2.9	28.8	62.9	2.2
150	450	200	4.6	7.4	1.6	71.7	268.5	3.7	38.7	108.1	2.8
200	600	300	4.4	6.6	1.5	71.4	323.5	4.5	44	171.2	3.9
250	750	400	9.1	14	1.5	69.2	372.5	5.4	43.9	230.9	5.3
300	900	500	13.8	26.7	1.9	71.4	426	5.9	46.4	279	6
400	1,050	600	19.3	38.5	2	63.8	419.5	6.6	49.1	307.9	6.3
500	1,200	700	22.9	52.2	2.3	71.8	428	5.8	43.4	306.1	7
750	1,350	800	23.5	59.1	2.5	67	478	7.1	45.4	352.8	7.7
1,500	1,500	1,000	20.7	63.2	3.0	66.6	437	6.6	46.5	392.9	8.4

BUCKWHEAT AND RAPE.

Amount of P_2O_5 Applied Per Box.			Buckwheat — 1901-2.			Rape — 1901-2.		
1900-01.	1901-02.	1903-04.	Yield dry matter.	P_2O_5 used.	P_2O_5 per gram dry matter.	Yield dry matter.	P_2O_5 used.	P_2O_5 per gram dry matter.
Mgr.	*Mgr.*	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*
	Blanks.		5.1	19	3.8	5	28	5.6
0	0	0	13	54	4.1	29.9	64.5	2.1
50	150	50	13.7	81.5	5.9	45.8	141.5	3.1
100	300	100	13	102	7.8	49.8	193.5	3.9
150	450	200	14.4	160.5	11.1	54.7	271	4.9
200	600	300	12.7	203.5	16	55.7	327.5	5.9
250	750	400	12.2	230	18.9	54.2	358	6.6
300	900	500	11.5	297	25.8	54.4	385.5	7.1
400	1,050	600	12.5	341.5	27.3	52.5	416	7.9
500	1,200	700	10.4	285.5	27.4	52.7	408	7.7
750	1,350	800	10.3	330.5	32	56.7	468	8.1
1,500	1,500	1,000	11.3	345.5	30.6	58.1	478.5	8.2

TABLE VI (*concluded*).

TOMATOES.

Amount of P_2O_5 Applied per Box.		1901-2.			1903-4.		
1901-02.	1903-04.	Yield dry matter.	P_2O_5 used.	P_2O_5 per gram dry matter.	Yield dry matter.	P_2O_5 used.	P_2O_5 per gram dry matter.
Mgr.	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*
Blanks.		11.6	76	6.8	....	....	....
0	0	39.7	87.5	2.2	....	....	....
150	50	59.9	177	2.5	15.6	39.5	2.5
300	100	65.4	219.5	3.3	24.4	70.7	2.9
450	200	68	328.5	4.8	35.6	133.1	3.7
600	300	76.1	370.5	4.9	42.2	143	3.4
750	400	79.9	492.5	6.2	50.8	259.4	5.1
900	500	75.1	610.5	8.1	50.5	323.8	6.4
1,050	600	70.2	654.5	9.3	55.9	383.7	6.8
1,200	700	75.2	687	9.1	53.5	423.5	7.9
1,350	800	74.4	793	10.6	50.8	418.5	8.2
1,500	1,000	66.8	746.5	11.2	54.1	530.3	9.8

TABLE VII.— DRY SUBSTANCE PRODUCED IN PLANT-FOOD REQUIREMENT EXPERIMENTS: K_2O IN VARYING AMOUNTS, OTHER ELEMENTS IN FULL SUPPLY.

BARLEY.

Amount of K_2O Applied per Box.			1900-01.			1901-02.			1903-04.		
1900-01.	1901-02.	1903-04.	Yield dry matter.	K_2O used.	K_2O per gram dry matter.	Yield dry matter.	K_2O used.	K_2O per gram dry matter.	Yield dry matter.	K_2O used.	K_2O per gram dry matter.
Mgr.	*Mgr.*	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*
	Blanks.		5.5	8.6	1.6	29.5	....	......	18.4	242	......
0	0	0	16.1	107	6.6	126.3	401	3.18	......	......	......
100	100	100	21.2	.154	7.3	136.2	589.6	4.8	107.2	347	3.2
200	200	400	31.1	200	6.4	145.9	761	5.2	127.4	521	4.1
400	300	700	41	296	7.2	134.8	648	4.8	131.7	506	3.8
600	500	1,000	50.3	366	7.7	152.7	695	4.5	144.5	585	4.0
800	750	1,300	51.3	246	4.8	155	829	5.3	140.8	624	4.4
1,000	1,000	1,600	50	363	7.2	146.7	716	4.9	146.5	686	4.7
1,500	1,250	1,900	56.2	557	9.9	155.1	738	4.7	145.4	806	5.5
2,000	1,500	2,200	55.2	619	11.2	159.6	980	6.4	148.4	1,083	7.3
3,000	2,000	2,500	58.4	930	15.9	171.9	1,153	6.7	149	1,136	7.6
4,000	3,000	2,700	55.8	970	17.4	179.9	1,469	8.2	158.4	1,083	6.8

TABLE VII (*continued*).

PEAS.

Amount of K_2O Applied per Box.			1900–01.			1901–02.			1903–04.		
1900–01.	1901–02.	1903–04.	Yield dry matter.	K_2O used.	K_2O per gram dry matter.	Yield dry matter.	K_2O used.	K_2O per gram dry matter.	Yield dry matter.	K_2O used.	K_2O per gram dry matter.
Mgr.	*Mgr.*	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*
	Blanks.		3.6	60	16.6	15.6	250	16	15.6	271	17.4
0	0	0	11.6	104.5	9	55.3	572	10.4	......	......	......
100	100	100	13	116	9	53.2	545.5	10.3	72.8	673.5	9.2
200	200	400	12.5	107.5	8.6	56.9	635.5	11.2	70.6	776	10.9
400	300	700	18.3	324.5	17.7	52.7	953.5	18.1	69.7	861	12.3
600	500	1,000	12.3	179.5	14.6	59.1	1,192	20.2	71.2	1,026	14.4
800	750	1,300	13.8	256	18.5	46.4	1,001	21.5	73.7	1,210	16.4
1,000	1,000	1,600	14.8	329	22.2	56.3	1,063.5	78.8	73.7	1,241	16.8
1,500	1,250	1,900	18.5	511.5	27.7	53.4	1,100	20.6	74.6	1,361.5	18.2
2,000	1,500	2,200	16.4	494	30.1	53.8	1,269	23.6	73.2	1,502	20.5
3,000	2,000	2,500	16.1	637.5	39.6	64.3	1,691.5	26.3	64.4	1,508	23.4
4,000	3,000	2,700	11	487.5	44.3	54.8	1,658.5	30.3	73.9	1,622.5	21.9

TOBACCO.

Amount of K_2O Applied per Box.			1900–01.			1901–02.			1903–04.		
1900–01.	1901–02.	1903–04.	Yield dry matter.	K_2O used.	K_2O per gram dry matter.	Yield dry matter.	K_2O used.	K_2O per gram dry matter.	Yield dry matter.	K_2O used.	K_2O per gram dry matter.
Mgr.	*Mgr.*	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*
	Blanks.		......	......	......	15.4	522	33.9	7.7	194	26
0	0	0	11.3	122	10.8	64.8	1,221	18.8	......	......	......
100	100	100	7.5	56	7.5	67.9	1,116	16.4	43.7	537.5	12.3
200	200	400	10.9	78.5	7.2	70.6	1,454.5	20.6	47.7	772.5	16.2
400	300	700	13.5	105.5	7.8	73.1	1,032	14.1	47.4	736	15.5
600	500	1,000	15.1	109.5	7.2	70.8	1,360.5	19.3	47.9	956	19.9
800	750	1,300	16.7	160	10.2	71.5	1,837	25.7	48.9	1,281	26.1
1,000	1,000	1,600	18.8	230.5	12.2	72.3	1,946	26.9	49.4	1,482	30
1,500	1,250	1,900	19.3	212.5	11	73.8	1,975	26.8	46.6	1,387	29.8
2,000	1,500	2,200	21.3	307.5	14.4	71.8	2,065	28.7	43.6	1,322	30.3
3,000	2,000	2,500	25.4	431.5	17	71.6	2,111.5	29.5	48.4	1,455	30.1
4,000	3,000	2,700	20	324.5	16.2	69.5	2,422.5	34.8	50.2	1,698	33.8

TABLE VII (*concluded*).

TOMATOES.

Amount of K_2O Applied Per Box.			1900–01.			1901–02.			1903–04.		
1900–01.	1901–02.	1902–03.	Yield dry matter.	K_2O used.	K_2O per gram dry matter.	Yield dry matter.	K_2O used.	K_2O per gram dry matter.	Yield dry matter.	K_2O used.	K_2O per gram dry matter.
Mgr.	*Mgr.*	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*
	Blanks.		....	....	....	20	927	46.3	7.3	270	37
0	0	0	1.8	20	11.1	73.7	1,829	24.8	....	....	....
100	100	100	4.2	53.5	12.7	80.3	1,584	19.7	67.6	952	14.1
200	200	400	4.5	81	18	84.4	1,751	20.7	65.4	1,110	17
400	300	700	4.9	141	28.8	79.5	1,801	22.7	63	1,268	20.1
600	500	1,000	4.6	148.5	32.8	70.2	1,685	24	54.2	1,153	21.3
800	750	1,300	3.5	105.5	30.1	94.2	2,507	26.6	79.9	1,808	22.6
1,000	1,000	1,600	4.6	177.5	38.6	87	2,702	31	72.9	1,845	25.3
1,500	1,250	1,900	4.7	188	40	82	1,761	21.5	58.6	1,692	28.9
2,000	1,500	2,200	8.7	163	44	82.9	2,413	29.1	72.3	2,216	.30.6
3,000	2,000	2,500	6.2	329	53	88.5	2,855	32.3	72.7	1,990	27.3
4,000	3,000	2,700	2.9	149	51.4	65.8	2,795	42.5	68.6	2,350	34.3

BUCKWHEAT AND RAPE.

Amount of K_2O applied per box.			Buckwheat			Rape		
			Yield dry matter.	K_2O used.	K_2O per gram dry matter.	Yield dry matter.	K_2O used.	K_2O per gram dry matter.
Mgr.	*Mgr.*	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*
	Blank		13.3	421	31.6	3.8	96	2.5
0	0	0	14.7	329.5	22.4	60.7	911	15
100	100	100	15.9	359.5	22.6	61.7	735	11.9
200	200	400	17.3	473.5	27.4	66.2	1,123	17
400	300	700	17.7	551	31.1	62.3	1,178	18.9
600	500	1,000	19.4	681	35.1	65.5	1,297	19.8
800	750	1,300	20.5	719	35.1	58.6	1,189	20.3
1,000	1,000	1,600	20.9	754.5	36.1	64.1	1,529	23.8
1,500	1,250	1,900	17.1	746	43.6	61.7	1,743	28.2
2,000	1,500	2,200	18.8	896.5	47.1	66.2	1,927	29.1
3,000	2,000	2,500	21.9	1,038.5	47.4	60.8	2,255	37.1
4,000	3,000	2,700	20	1,050.5	52.5	65.5	2,382	36.4

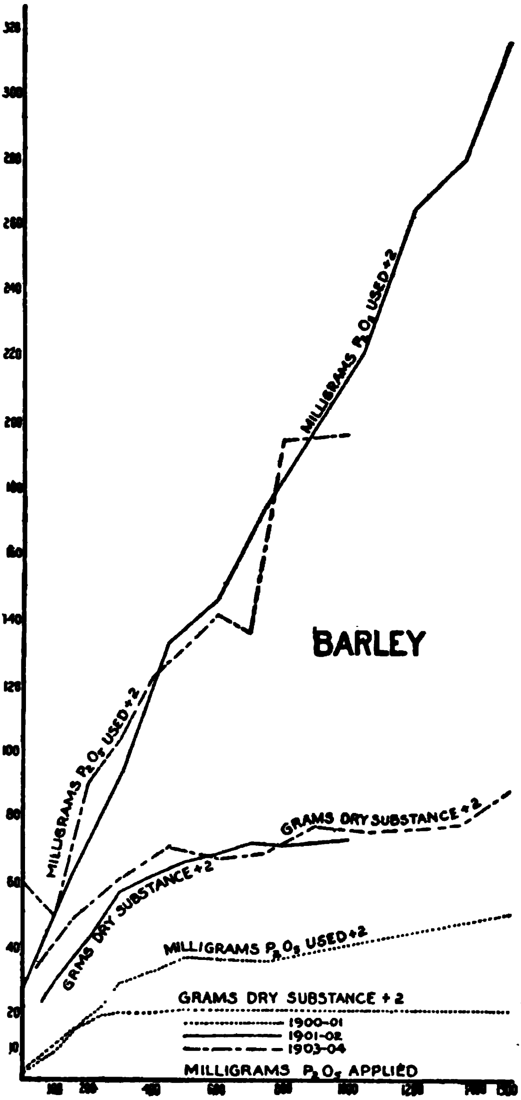

FIG. 8.—RELATION BETWEEN P_2O_5 SUPPLIED AND DRY SUBSTANCE PRODUCED BY BARLEY.

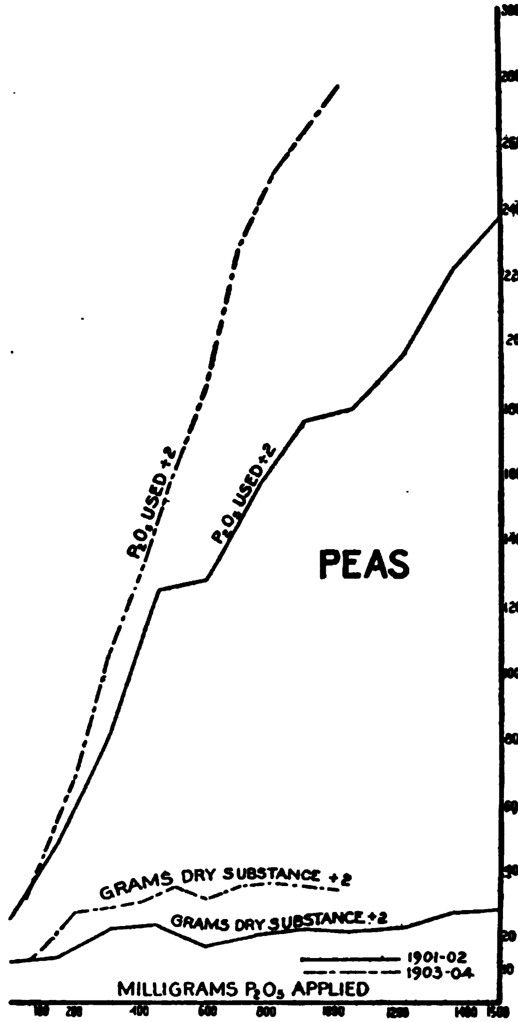

FIG. 9.—RELATION BETWEEN P_2O_5 SUPPLIED AND DRY SUBSTANCE PRODUCED BY PEAS.

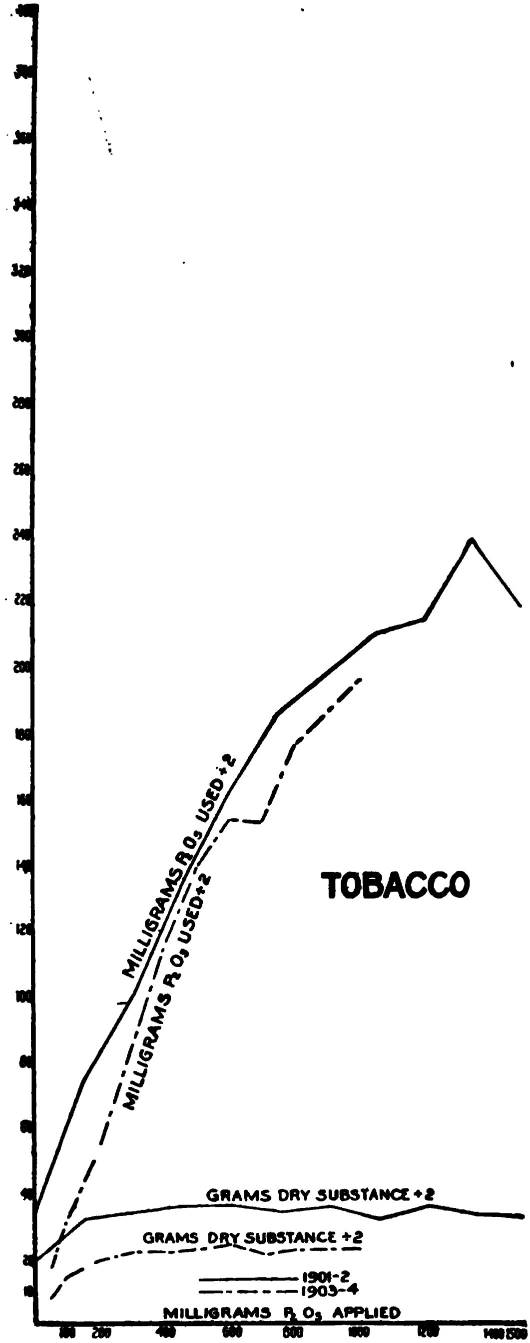

FIG. 10.—RELATION BETWEEN P_2O_5 SUPPLIED AND DRY SUBSTANCE PRODUCED BY TOBACCO.

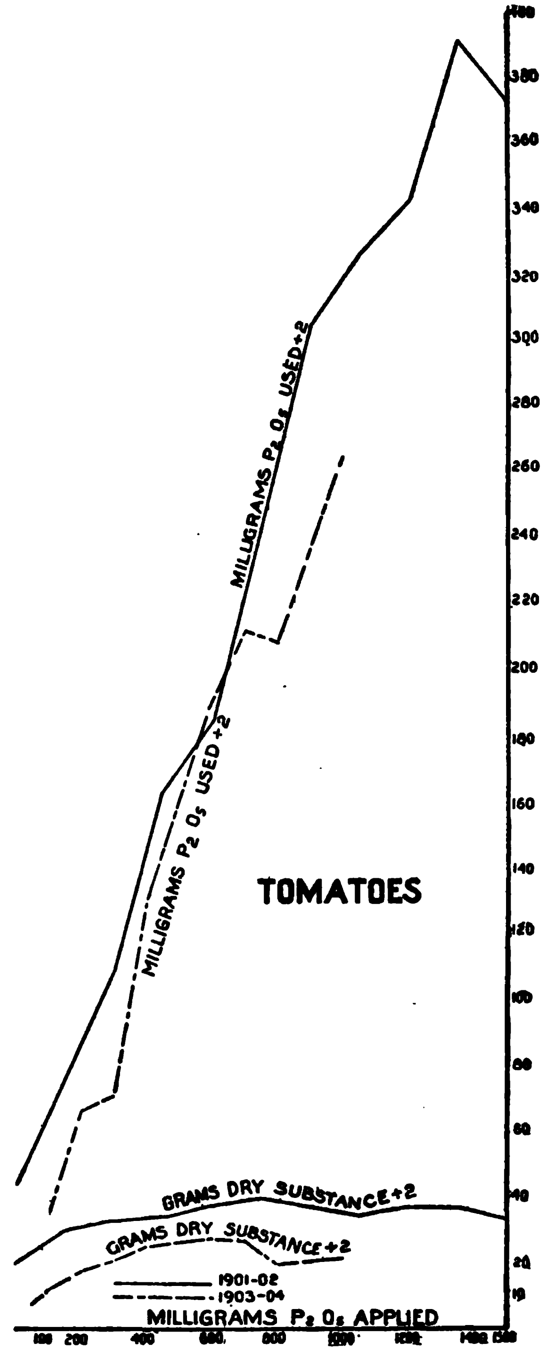

FIG. 11.—RELATION BETWEEN P_2O_5 SUPPLIED AND DRY SUBSTANCE PRODUCED BY TOMATOES.

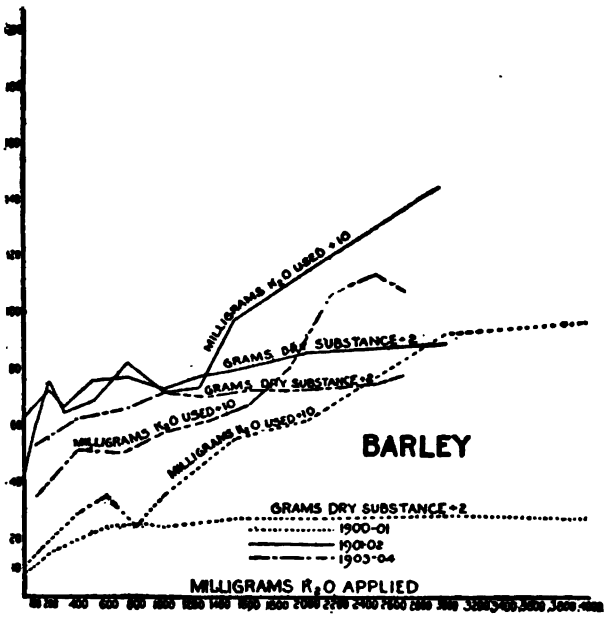

Fig. 12.—Relation between K_2O Supplied and Dry Substance Produced by Barley.

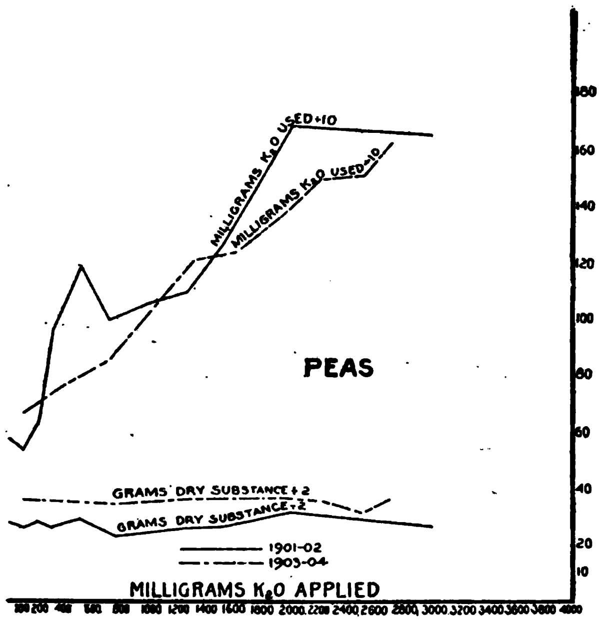

FIG 13.—RELATION BETWEEN K_2O SUPPLIED AND DRY SUBSTANCE PRODUCED BY PEAS.

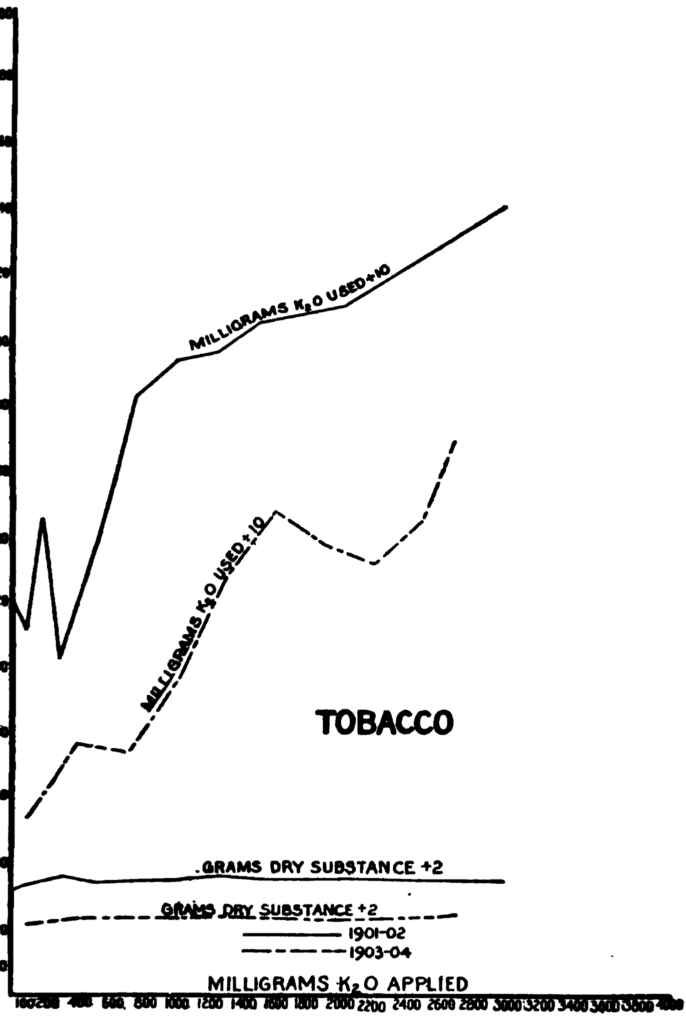

FIG. 14.—RELATION BETWEEN K_2O SUPPLIED AND DRY SUBSTANCE PRODUCED BY TOBACCO.

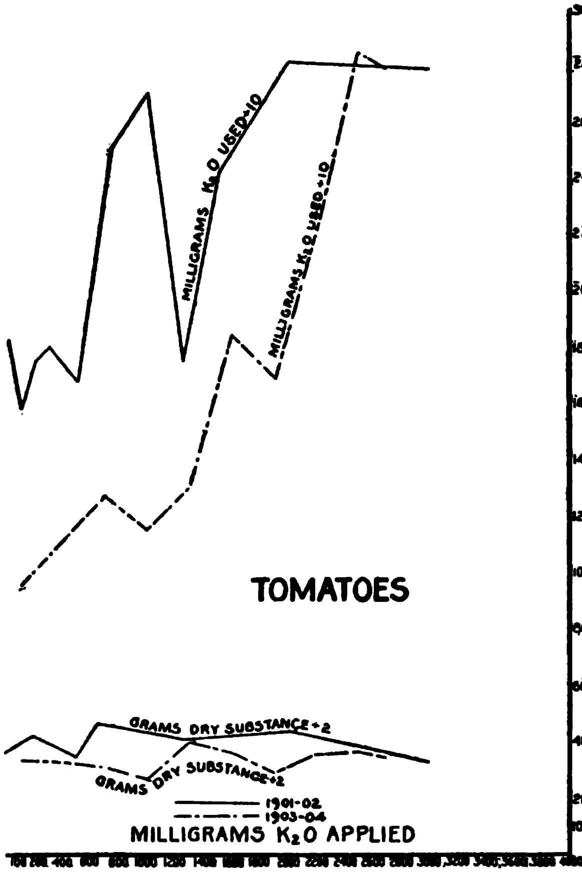

FIG. 15.—RELATION BETWEEN K_2O SUPPLIED AND DRY SUBSTANCE PRODUCED BY TOMATOES.

TABLE VIII.— DRY SUBSTANCE PRODUCED IN PLANT-FOOD REQUIREMENT EXPERIMENTS: P_2O_5 IN VARYING AMOUNTS IN 1900–1, K_2O IN VARYING AMOUNTS IN 1901–2, OTHER ELEMENTS IN FULL SUPPLY.

TURNIPS.

AMOUNT APPLIED PER BOX		1900–1, P_2O_5.			1901–2, K_2O.		
P_2O_5. 1900–1.	K_2O. 1901–2.	Yield dry matter.	P_2O_5 used.	P_2O_5 per gram dry matter.	Yield dry matter.	K_2O used.	K_2O per gram dry matter.
Mgr.	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*	*Grams.*	*Mgr.*	*Mgr.*
Blanks.		1.9	5.5	3	....	....	....
0	0	....	....	....	9.3	93	10
100	100	3.6	7.3	2	19	281	14.7
200	200	7.1	18.2	2.6	15.8	214.5	13.6
400	300	12.7	37.6	2.9	20.5	422.5	20.6
600	500	11.6	39.1	3.4	15.5	280	18
800	750	15.6	60.6	3.9	18	350	19.4
1,000	1,000	13.3	58.2	4.4	20.1	509	25.3
1,500	1,250	16.2	79.5	4.9	19.9	642	32.3
2,000	1,500	17.7	99.3	5.6	23.1	700	30.3
3,000	2,000	15.2	92.5	6.1	21.8	1,025.5	47
4,000	3,000	17	145.3	8.5	19.3	1,107	57.3

TABLE IX.— SUMMARY OF RELATION BETWEEN DRY SUBSTANCE PRODUCED AND P_2O_5 UTILIZED IN PLANT-FOOD REQUIREMENT EXPERIMENTS.

BARLEY, PEAS, TOBACCO, TOMATOES.

	Barley.	Peas.	Tobacco.	Tomatoes.
1900–01.				
Change in P_2O_5 applied........	250 to 1,500	....	400 to 1,500	....
Change in dry matter in crop..	40 to 44.1	....	19.3 to 20.7	....
Change in P_2O_5 used..........	56.1 to 101.9	....	38.5 to 63.2	....
Change in relation P_2O_5 to dry matter..................	1.4 to 2.3	....	2 to 3	....
1901–02.				
Change in P_2O_5 applied........	4.50 to 1,500	300 to 1,500	300 to 1,500	300 to 1,500
Change in dry matter in crop..	142.6 to 178	45.4 to 57.8	68.1 to 66.6	65.4 to 66.8
Change in P_2O_5 used..........	268 to 632	171.5 to 477.5	200 to 437	219.5 to 746.5
Change in relation P_2O_5 to dry matter..................	1.88 to 3.55	3.7 to 8.3	2.9 to 6.6	3.3 to 11.2
1903–04.				
Change in P_2O_5 applied........	500 to 1,000	200 to 1,000	300 to 1,000	400 to 1,000
Change in dry matter in crop..	134 to 147.2	56.1 to 70.3	44 to 46.5	50.8 to 54.1
Change in P_2O_5 used..........	264.4 to 394.8	140 to 555.2	171.2 to 392.9	259.4 to 530.3
Change in relation P_2O_5 to dry matter..................	1.97 to 2.7	2.5 to 7.9	3.9 to 8.4	5.1 to 9.8

TABLE X.—SUMMARY OF RELATION BETWEEN DRY SUBSTANCE PRODUCED AND K_2O UTILIZED IN PLANT-FOOD REQUIREMENT EXPERIMENTS.

BARLEY, PEAS, TOBACCO, TOMATOES.

	Barley.	Peas.	Tobacco.	Tomatoes.
1900–01.				
Change in K_2O applied	600 to 4,000	....	....	....
Change in dry matter in crop	50.3 to 55.9	....	....	....
Change in K_2O used	366 to 970	....	....	....
Change in relation K_2O to dry matter	7.7 to 17.4	....	....	....
1901–02.				
Change in K_2O applied	500 to 3,000	0 to 3,000	100 to 300	0 to 3,000
Change in dry matter in crop	152.7 to 179.9	55.3 to 54.8	67.9 to 69.5	73.7 to 65.8
Change in K_2O used	695 to 1,469	572 to 1,658.5	1,116 to 2,422.5	1,829 to 2,795
Change in relation K_2O to dry matter	4.5 to 8.2	10.4 to 30.3	20.6 to 34.8	24.8 to 42.5
1903–04.				
Change in K_2O applied	1,000 to 2,700	100 to 2,700	400 to 2,700	100 to 2,700
Change in dry matter in crop	144.5 to 158.4	72.8 to 73.9	47.7 to 50.2	67.6 to 68.6
Change in K_2O used	585 to 1,083	673.5 to 1,622.5	772.5 to 1,698	952 to 2,350
Change in relation K_2O to dry matter	4 to 6.8	9.2 to 21.9	16.2 to 33.8	14.1 to 34.3

COMMENTS ON RESULTS.

The foregoing tables present results that are striking in their uniformity and agreement.

In considering these results it is not to be forgotten that they were secured by the use of artificial soils much less complex in composition and reactions than natural soils. Moreover, the temperature and water supply were under control and were regulated so far as possible to meet more fully the plants' needs. Under these conditions it may be held with some reason that the results of the experiments are not applicable to outdoor conditions. It is hardly to be expected, however, that such a difference in the environment of plants would materially modify the processes of growth or cause new physiological reactions. It is certain that, as shown in the next table, in most instances the conditions permitted a growth of the plants that would be satisfactory for field crops, the production of dry matter with the barley in two of the three experiments being beyond what could reasonably be expected in a farm crop.

It is clearly shown that under the conditions involved no fixed relation was maintained between the production of dry matter and the amounts of phosphorus and potassium utilized.

Up to a somewhat indefinite point the production of plant substance increased in most cases with the increase in the supply of the variable constituent, but beyond that point the utilization of both phosphorus and potassium compounds increased without any consistent and well defined corresponding increase of plant

TABLE XII.— COMPUTED MAXIMUM ACRE YIELD OF DRY SUBSTANCE IN CROPS GROWN IN BOXES, IN PLANT-FOOD REQUIREMENT EXPERIMENT.

	1900-01.		1901-02.		1903-04.	
	Variable P_2O_5.	Variable K_2O.	Variable P_2O_5.	Variable K_2O.	Variable P_2O_5.	Variable K_2O.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Barley	2,696	3,571	10,884	10,991	9,001	9,686
Buckwheat	....	....	880	1,339	....	....
Peas	801	1,131	3,533	3,932	4,518	4,562
Rape	....	....	3,553	4,048	....	....
Tobacco	1,437	1,553	4,390	4,513	3,012	3,070
Tomatoes	....	379	4,886	5,760	3,418	4,886
Turnips	1,082	1,412	....	....	....	....

growth. Indeed, it may be said safely that there was in practically all cases a quite regular increase in the proportion of phosphorus and potassium compounds in the plants of the several species corresponding to the supply of these compounds in the soil.

It was hoped that by repeating these experiments during several seasons some quite definite minimum relation between the necessary phosphorus and potassium and the dry matter produced would be established. The data secured do not establish such a relation. It is quite possible that other factors obscured the limitations of the plant food supply.

The results reached do strongly emphasize the fact that the amounts of soil compounds used by agricultural plants are materially influenced by the chemical environment of the roots.

It is therefore not necessarily true that what a given crop contains of certain elements is to be regarded as a measure of what must be supplied in order to meet the needs for maximum growth under the existing conditions. It seems more than probable that in field practice a liberal supply of highly available plant food compounds increases the amounts of these compounds utilized out of proportion to the growth of dry matter.

Formulae based on crop analysis are therefore only approximations to the real needs of the crop.

THE ACTION OF RENNIN ON CASEIN*†

ALFRED W. BOSWORTH.

SUMMARY.

A solution of calcium caseinate neutral to litmus and free from all other salts is not curdled by rennin.

A solution of calcium caseinate acid to litmus, which contains two equivalents of base for each molecule of casein, is curdled by rennin.

Solutions of ammonium, sodium or potassium caseinates are not curdled by rennin. In such solution, however, the casein is changed to paracasein, the paracaseinates of these bases being soluble.

When paracasein is produced from casein by the action of rennin no other substance is formed. Two molecules of paracasein are produced from each molecule of casein as a result of this action.

Rennin is not, strictly speaking, a coagulating ferment; the coagulation being a secondary effect, the result of a change in solubilities.

Rennin action is probably a hydrolytic cleavage and may be considered the first step in the proteolysis of casein. It would follow from this that the action now attributed to rennin may be produced by any proteolytic enzyme. Work along this line is being carried out by the author.

In the light of the results reported in this paper together with those of Van Slyke and Bosworth the retarding action of soluble salts of ammonium, sodium and potassium on the coagulation of milk or casein solutions by rennin may be explained as follows: The addition of salts of these bases to milk or casein solutions results in a double decomposition whereby the calcium caseinate is changed to a caseinate of the base added. These are converted to paracaseinates by rennin, but owing to the fact that all the paracaseinates of these bases are soluble, no coagulation results.

INTRODUCTION.

The changes produced by the action of rennin in milk and solutions of casein have been the subject of many investigations. Fremy [1] was probably the first to give an explanation of this phenomenon. He believed the power to coagulate milk possessed by an extract of the mucous lining of a calf's stomach to be due to the presence

* Also printed in *Jour. Biol. Chem.*, 15:231–236, as a contribution *"From the Biochemical Laboratory of the Harvard Medical School, Boston, and the Chemical Laboratory of the New York Agricultural Experiment Station, Geneva, N. Y."*

† Reprint of Technical Bulletin No. 31, September, 1913.

[1] Fremy: *Ann. de pharm.* (Liebig), *31*: 188, 1839.

of an enzyme which converts some of the lactose of the milk into lactic acid, the acid thus formed precipitating the casein.

Hammarsten [2] was the first to show that this coagulation of milk is due to the presence of a soluble ferment which acts directly upon the casein, producing, as he thought, two substances, the insoluble curd, *Käse*, which we call paracasein and a soluble product which he called whey-protein (*Molkeneiweiss*). He also showed that the change of casein to paracasein is independent of coagulation, the coagulation being due to the presence of soluble calcium salts.[3]

A great number of papers have been published upon this subject since the early work of Hammarsten.[4] As his explanation of the action of rennin has been generally accepted as correct, most of the recent investigations have been concerned with the influence of soluble salts upon the coagulation. These investigations have shown that the soluble salts of calcium, barium and strontium favor or hasten coagulation while salts of ammonium, sodium and potassium retard or inhibit coagulation.

Recently Van Slyke and Bosworth[5] have shown that casein and paracasein are acids having the same percentage composition; that the molecular weight of casein is probably 8888 ±, while the molecular weight of paracasein is one-half that of casein; that both have a combining equivalent of 1111; that combinations of casein or paracasein with one equivalent of calcium, barium or strontium are insoluble in water while the combinations with one equivalent of ammonium, sodium or potassium are soluble; and that ammonium, sodium or potassium caseinates can be changed by rennin to paracaseinates which are soluble and are precipitated by calcium chloride as calcium paracaseinates.

These facts would seem to indicate three things:

First, that rennin action consists of the hydrolytic splitting of the casein molecule into two similar molecules of paracasein; perhaps in somewhat the same manner that maltose is split into two molecules of dextrose.

Second, that, as a consequence of this cleavage it would seem to be doubtful if Hammarsten's whey-protein could be one of the products of rennin action.

Third, that rennin is not, strictly speaking, a coagulating ferment, the coagulation of paracasein being due to the fact that calcium paracaseinates are less soluble than the calcium caseinates, especially in the presence of soluble salts of calcium, barium or strontium.

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[2] Hammarsten: *Maly's Jahresbericht*, 1872, p. 118; 1874, p. 135; 1877, p. 158.
[3] See also Arthus and Page: *Arch. de physiol.* (5th series), ii.
[4] An excellent review of the literature with references may be found in Bulletin 56 of the Hygienic Laboratory of the Public Health and Marine Hospital Service of the United States.
[5] Van Slyke and Bosworth: *Jour. Biol. Chem.*, 14:203–236.

EXPERIMENTAL

This investigation was undertaken as an attempt to determine the truth of the statements made above. In repeating the work of Hammarsten and others a soluble substance which had not been coagulated by rennin and could not be precipitated by dilute acetic acid was always found in the filtrate. Casein solutions for such investigations have been prepared, as a general rule, by shaking pure casein with an excess of lime water or by grinding with moist calcium carbonate. The casein solutions thus obtained were made neutral to litmus and coagulated by the addition of rennin. The curds were filtered off and the filtrates examined for nitrogen. Soluble nitrogen was always found, but the amounts were not constant and seemed to have no relation to the amounts of casein or rennin used. In the control experiments, to which no rennin had been added, similar amounts of nitrogen which could not be precipitated by dilute acetic acid were also found.

Caseinate solutions prepared in the manner described contain basic caseinates, either neutral or alkaline to phenolphthalein. As Robertson[6] has shown that such caseinates in solution undergo an autohydrolysis, the following experiment was carried out in order to determine if this might account for the soluble nitrogen found.

Five grams of casein were dissolved in 250 cc. of $\frac{N}{50}$ calcium hydroxide in the presence of toluol. After complete solution of the casein, portions of the solution were withdrawn at intervals and the casein precipitated by means of dilute acetic acid. The casein was filtered off and the nitrogen in the filtrates determined by the microchemical method devised by Folin.[7] The results are as follows:

	3 hours	15 hours	24 hours
Milligrams of nitrogen in original solution	158	158	158
Milligrams of nitrogen not precipitated by rennin	4.0	10.0	28.8

Results of the same nature were obtained with solutions made by grinding casein with moist calcium carbonate. The extent of this autohydrolysis, temperature being constant, depends upon time. As dry casein goes into solution very slowly and freshly precipitated casein is quite rapidly redissolved the following procedure was adopted in order to circumvent autohydrolysis.

Ten grams of pure dry casein were dissolved in 500 cc. of $\frac{N}{50}$ calcium hydroxide. The casein was then precipitated by adding about

[6] Robertson: *Jour. Biol. Chem.* 2:344; see also Osborne: *Jour. Physiol.*, 27:398.

[7] Folin and Farmer: *Jour. Biol. Chem.*, 11: 493. All nitrogen determinations reported in this paper were made by this method.

250 cc. of $\frac{N}{25}$ acetic acid, the liquid was siphoned off, the casein washed several times with water, placed in a linen bag and squeezed as dry as possible. It was then transferred to a mortar, ground to a paste with a little water, the paste put into a flask and 150 cc. of water, 75 cc. of lime water and some toluol were added to it. After considerable shaking the lime water became saturated with casein. By this process a solution was obtained containing a calcium caseinate neutral to litmus but acid to phenolphthalein,[8] and containing four equivalents of base. The undissolved casein was removed by centrifuging and filtering. The amount of casein in solution was determined and the solution so diluted that each 50 cc. contained 1 gram of casein. Fifty cc. portions of this solution were withdrawn at intervals and precipitated with acetic acid. The amounts of nitrogen found in the filtrates were as follows:

	30 minutes	5 hours	12 hours	24 hours
Milligrams of nitrogen in original solution	158	158	158	158
Milligrams of nitrogen not precipitated by acetic acid	0.07	0.92	1.96	2.00

Casein solutions prepared in this manner gave the following reactions. *They were not coagulated by rennin.* The addition of a few drops of a 10 per ct. solution of calcium chloride caused them to curdle;[9] the addition of one drop caused no change but the subsequent addition of rennin produced coagulation. If enough hydrochloric acid was added to change the caseinate to one containing two equivalents of calcium,[10] the addition of rennin caused coagulation. That this coagulation was not due to the calcium chloride formed by the acid was shown by the fact that rennin caused coagulation after all this calcium chloride had been removed by dialysis. In both instances *the coagulation removed all the nitrogen from the solution*, as is shown by the following figures:

Milligrams nitrogen in original solution	Milligrams nitrogen not precipitated by rennin
316	0.8
316	0.6
316	0.2±

The behavior of such caseinate solutions toward rennin can be explained by the work of Van Slyke and Bosworth as follows:

[8] Robertson: *Jour. Biol. Chem.*, 2: p. 317; Van Slyke and Bosworth: *ibid.*, 14: p. 211–225.

[9] Robertson: *ibid.*, 2: 381. Robertson believes that the addition of the common Ca ion represses the dissociation of the caseinate and thus causes precipitation.

[10] Van Slyke and Bosworth: *ibid.*, 14: pp. 211–225.

A molecule of calcium caseinate containing four equivalents of base is split by rennin into two molecules of paracaseinate, each containing two equivalents of base. Such a paracaseinate is soluble in pure water but insoluble in the presence of more than a trace of a soluble calcium salt. A molecule of calcium caseinate containing two equivalents of base is split by rennin into two molecules of paracaseinate each containing one equivalent of base. Such a paracaseinate is insoluble in pure water.

The small amounts of nitrogen recovered in the filtrates in the experiments given above may be due to autohydrolysis or to proteolysis produced by the pepsin in the rennin extract used, as is indicated by the following experiment.

Into each of several flasks were placed 50 cc. of a casein solution and a little toluol. One-half of the flasks received a few drops each of rennin solution, the others being kept as controls. The contents of the flasks were examined at intervals for autohydrolysis and proteolysis. The nitrogen in the control flasks which was not precipitated by acetic acid was considered as due to autohydrolysis; while in the case of the other flasks the nitrogen not removed by filtering was considered to be due to autohydrolysis and proteolysis. By subtracting the nitrogen found in the controls from those containing rennin a fair idea as to the extent of the proteolysis might be obtained.

	30 minutes	12 hours
Milligrams of nitrogen in original solution as casein	158	158
Milligrams of nitrogen in filtrate from rennin flasks	3.4	18.2
Milligrams of nitrogen in filtrates from control autohydrolysis	0.1	2.1
Milligrams of nitrogen due to proteolysis	3.3	16.1

Solutions of ammonium, sodium or potassium caseinates containing two or more equivalents of base could not be coagulated by rennin, but the subsequent addition of calcium chloride caused coagulation, the curd being calcium paracaseinate. That sodium caseinate in solution was changed to sodium paracaseinate was shown by the following experiment. Rennin was added to a solution of sodium caseinate and after a short time acetic acid was added. The precipitate, after being purified and dried, was found to be paracasein.

In conclusion I wish to express my appreciation of the interest in this work shown by Dr. L. L. Van Slyke, of the Chemical Laboratory of the New York Agricultural Experiment Station, Geneva, N. Y., and Dr. Otto Folin of the Biochemical Laboratory of the Harvard Medical School, Boston, Mass.

REPORT

OF THE

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W. J. Schoene, *Associate Entomologist.*

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REPORT OF THE DEPARTMENT OF ENTOMOLOGY.

THE GRAPE LEAF-HOPPER.*

F. Z. HARTZELL.

SUMMARY.

This bulletin deals with studies on the hibernating habits and spring food-plants of the grape leaf-hopper and with experiments to establish efficient spraying practices.

Large numbers of adults survived the winter of 1911–12 and threatened many vineyards, but weather conditions during the summer were unfavorable for the nymphs, causing a decrease of the insects during the late summer and autumn of 1912.

The most favorable hibernating places for the leaf-hopper are fence rows, woods, brush and waste land, weeds or situations where leaves accumulate by the wind. Grass which has lodged also affords winter shelter to the insects. The drier, well-drained soils are more conducive to the safe wintering of the adults than the heavier soils.

Green cover crops do not afford suitable hibernating places for the grape leaf-hopper during severe winters.

The foliage of raspberry, strawberry, blackberry, currant, gooseberry, catnip, Virginia creeper, burdock, beech and sugar maple is eaten by the grape leaf-hopper before it migrates to the foliage of the grape. Strawberry and raspberry are the preferred spring food plants. The insects migrate from the strawberry to the raspberry during early May and from the raspberry to the grape during the latter part of May.

Mating of the hibernated adults takes place on the spring food plants.

The foliage of the grape is injured by the overwintering adults, but most of the feeding is restricted to the lower leaves, especially those on the young shoots or suckers at the base of

* Reprint of Bulletin No. 359, February, 1913; for Popular Edition, see p. 727.

the vine. The amount of injury to vineyards varies directly with their proximity to favorable hibernating places and spring food plants.

Spraying experiments during 1912 showed, (1) that Black Leaf 40, one part to 1600 parts of water or bordeaux mixture, is an efficient spray for the leaf-hopper. (2) The automatic attachment is a practical machine in the hands of careful sprayers. (3) The fruit from vines protected from the leaf-hopper is superior to fruit from vines subjected to the attacks of this pest. Chemical analyses of grapes from sprayed vines gave a gain of from 8 to 68 per ct. in sugar over those from untreated vines, while the unsprayed grapes had from 0 to 20.6 per ct. more acid than sprayed grapes.

The destruction of hibernating places of the grape leaf-hopper is recommended as a method of control, especially to save the young foliage of the grape in the spring.

When hibernating adults are on the young foliage, delaying the removal of the young shoots at the base of the vine will tend to keep the insects on the lower leaves and thus afford some protection to the more permanent foliage. The lower shoots should be removed just previous to spraying.

INTRODUCTION.

Experiments to develop efficient spraying practices to control the grape leaf-hopper have been conducted for three seasons and a part of the results of this work have been published.* During the past year additional facts have been gathered which have to do largely with the hibernating and early spring habits of this insect. These studies have emphasized the importance of certain control measures which are designed principally to protect the young foliage of the grape during the latter part of May and June when it is impracticable to attempt to combat the pest by spraying. Moreover the increasing use of cover crops, due to the recommendations of the Horticultural Department, has prompted some

* N. Y. Agr. Expt. Station Buls. Nos. 331 and 344.

studies to ascertain if the plants are attractive to the insects for purposes of hibernation and the effects, if any, of cover crops in promoting attacks on the vines early in the spring. Chemical analyses of grapes have shown the effects of injured foliage, due to the work of this pest, on the quality of the fruit. These phases of the problem are of much importance at this time owing to the abundance of the leaf-hoppers for the past two years and the danger that exists of these insects appearing in destructive numbers in certain of the grape-growing sections. This bulletin is designed to place before the grape-growers of the State the facts recently acquired and recommendations based on them.

CONDITIONS WITH RESPECT TO LEAF-HOPPER DURING 1912.

This insect was very abundant during the latter part of the summer of 1911 and it is estimated that in Chautauqua county alone at least one-fourth of the vineyards, representing approximately ten thousand acres, showed extensive feeding on the foliage by this species. The conditions with respect to this pest in other grape regions of the State were similar. The winter of 1911–12 proved to be severe and hopes were entertained that this would cause a high mortality among the hibernating adults. However, with the arrival of spring the leaf-hoppers emerged from their winter quarters in great numbers and seriously injured the young foliage in many vineyards. This invasion of the vines caused considerable apprehension among growers and led to more extensive spraying to combat the insect than has heretofore been practised in this region.

Considering the summer as a whole considerable injury was done to vineyards; yet the damage was less than was expected because of the cool weather during June, July, August and September. The weather conditions during this period were unusual as will be noted from the accompanying record:* The temperature for June was 106 degrees below normal — a daily deficiency of 3.5 degrees; July was slightly below normal; August gave a deficiency

* From the Monthly Meteorological Summary for 1912 of the U. S. Weather Bureau, for Buffalo, N. Y., which is forty-five miles distant from Fredonia.

of 125 degrees — a daily average of 4 degrees; September temperatures were 59 degrees above normal — a daily excess of 1.7 degrees. In the months when growth is most active — May to September — there was a deficiency of 148 degrees — 1 degree daily.

The amount of precipitation for May, August and September was above the normal while June and July were deficient in rainfall. From the middle of July until the end of September there was an excess of rainfall and cloudy weather combined with the low temperatures. There were only four clear days between July 15th and 31st and August had only one clear day, the others being cloudy or partly cloudy. The percentage of sunshine during August was 42 — 23 per ct. below normal — while the rainfall was 4 inches or 1.01 inches above normal, 40 per ct. more than in a normal year. September had 11 clear days, 53 per ct. of sunshine, 8 per ct. departure from normal, and an excess rainfall of 0.13 inch or 4 per ct. above the average. These abnormal weather conditions were unfavorable to plant growth, and appeared to be especially detrimental to the grape leaf-hopper since it prevented a second summer brood and apparently interfered with the health of the nymphs as well as the adults. This has resulted in a greatly decreased number of hoppers going into winter quarters during the fall of 1912 compared with the number in the preceding autumn. Judging from the conditions prevailing during the autumn many acres of vineyards are in danger of severe infestation in the spring, although not as many as in 1912. The unfavorable weather conditions interfered with the proper ripening of the fruit in many vineyards, irrespective of their conditions with regard to the insect, but the interference with the ripening and quality was most marked when the leaf-hopper injury was severe.

BIOLOGICAL STUDIES.

HIBERNATION HABITS.

The adult leaf-hoppers remain on the vines until most of the foliage drops to the ground. During autumn they may be observed among fallen leaves, cover crops, weeds and grass that may

be present in the vineyards. The normal time of entrance into permanent hibernation quarters is from the latter part of October until the early portion of December, depending on weather conditions. Warm, sunny days during this time, or even during the winter, cause the hoppers to fly about more or less. Since the various hibernating places have a direct bearing on the infestation of vineyards, considerable study was given to the habits of the insect during this season.

FIG. 16—ADULT GRAPE LEAF-HOPPER. (Enlarged.)

Green weeds or green grasses, except where the upper portions are dead and lodged, do not usually afford favorable places for the wintering of the leaf-hoppers. However the grasses, such as the fox-tail grass (*Setaria glauca*), that grow in abundance during late summer on cultivated land and which die and lodge either about large weeds and corn stubble or about their own roots, offer excellent shelters to the insects, and large numbers of them exist in such situations. Plate IV, fig. 3, shows clumps of grass which were sheltering many leaf-hoppers in April after the very severe winter of 1911–12. Grassy headlands (Plate V, figs. 1–2), grass and rubbish along ditches or fence rows (Plate IV, figs. 1–2, and Plate VIII, figs. 2–3) are capital places for the insects during the winter. Burdock has large flat leaves which remain green during the winter and these shelter the pests. Raspberry and blackberry patches (Plate VI) as well as woodland or waste land which retain many leaves are favorite places for hibernating hoppers. Old stumps which have had many holes eaten into them by borers were found to shelter hundreds of leaf-hoppers. The firmer leaves of trees when carried by the wind and caught in the locations mentioned above are perhaps the most powerful single influence in making these places favorable shelters as they do not pack together tightly, but offer the insects many safe hiding places. While the adults may be observed during the months of November and December among various plants growing in the vineyards, careful search during the spring has so far failed

to reveal any of the insects in green cover crops or among fallen grape leaves as these appear to be pressed too tightly by the snow for the hoppers to survive. Usually such green cover crops are not high enough to catch many leaves and so are not conducive to sheltering the leaf-hoppers. Cover crops examined were cow-horn turnips, wheat, clover, rye and vetch. Chickweed (*Stellaria media*) in vineyards has also not been found to shelter the insects.

EFFECTS OF MOISTURE AND COLD ON INSECTS.

The leaf-hopper survives the winter in greatest numbers in dry locations and is absent from low-lying land, such as the clay and some of the loam soils. On the higher soils — the gravel and large areas of the loam soils — there is no winter flooding and the rains soon drain away, thus offering the driest winter quarters to be found in the grape belt. Here the leaf-hopper abounds. Although wet situations are not favorable to them, the insects are not easily drowned. They are able to walk on water for a considerable time without drowning. They are even able to rise on wing from the surface of water, at least in the summer when the temperature is higher, and no doubt are able to withstand considerable water during the winter. Notwithstanding all these protective adaptations they instinctively seek dry winter quarters. This species is also able to withstand considerable cold, and it does not seem as though our normal winters influence appreciably the numbers of the leaf-hoppers. The winter of 1911–12 was extremely severe. Low temperatures prevailed, as well as other unfavorable factors such as winter rains followed by snow, which soaked and packed down leaves and froze them together, while the temperature at one time dropped to 18° below zero and later to 14° below. Yet with all these apparently unfavorable conditions the numbers of adults appearing in the spring did not indicate a high mortality.

SPRING FOOD PLANTS.

From the first warm days in the spring until the grape foliage appears, the leaf-hoppers feed, especially during the warmer days,

on a number of species of plants. The most important are raspberry, blackberry, strawberry, burdock (*Arctium* sp.), catnip (*Nepeta cataria*), Virginia creeper (*Psedera quinquefolia*), currant and gooseberry. Their preferences are in the order given, raspberries always being favored when in foliage while strawberries are sought if the raspberries are not in leaf. The observations made during 1912 in a locality where the chosen plants existed showed that from the time of the first warm weather, about April 15 to May 6, the principal feeding was on the leaves of the wild strawberry (*Fragaria* sp.) (Plate VII, fig. 2), and that on May 6 they began to feed on the lower leaves of the black raspberry, which were at this time about one and a half inches long. At this latter date the Burbank plum and sweet cherry were coming into bloom, while the buds of the Concord grapes were just bursting. By May 10 most of the hoppers were found feeding on the foliage of raspberries, principally on the lower leaves, very few being found more than half way to the top of the bushes. By May 15 all portions of the foilage were attacked (Plate VII, fig. 1). Migration of the insects from raspberries to grapes began May 20, at which time grape foilage appeared as in Plate VIII, fig. 1. This movement of the insects was at its height about May 24, when grapes were at the stage of growth shown in Plate IX. By June 1, practically all of the leaf-hoppers had made their way to the grape vines.

An interesting observation was taken May 24 in a small area of woodland which sheltered many leaf-hoppers during the winter. There were no raspberries, blackberries nor strawberries present in the vicinity so that the hoppers were compelled to feed on other plants. A few vines of the Virginia creeper served as food for a number of the insects, but most of them had been feeding on the leaves of the beech (*Fagus grandifolia*) and sugar maple (*Acer saccharum*). Both species of trees appeared to be badly infested on the lower branches, but, however, beech and maple usually escape attacks from this insect when the favorite food-plants as listed above are present.

MATING HABITS.

Accounts of the copulatory habits of this species are meagre, but our studies show that the hibernating insects mate while feeding on the raspberry and various plants other than the grape. The first pair in copulation was observed on burdock about ten o'clock on May 20. The weather was fair with a maximum temperature for the day of 63° F., and the sun was shining. This appeared to be the beginning of the mating season as the weather previous to this time had been cold and wet, during which time the insects were sluggish. The next day a copulating pair was observed on a raspberry leaf for about one hour, at about noon. The maximum temperature for the day was 68° F. Mating is accomplished by the male and female bringing the ends of their abdomens together. They remain very quiet except that the claspers of the male are almost continuously active. A slight disturbance will cause them to separate. No mating by the overwintering adults was observed on grape foliage. Many of the males die shortly after copulation as the following facts show: May 20, 225 leaf-hoppers were captured on the raspberry bushes of which 112 were males and 113 females, but during the latter part of May when the migration to the grape was nearly completed the females predominated, there being about one-fourth as many males as females. During the early part of June it was difficult to find males, while the females were numerous. A pair of the summer brood was observed mating on July 23. Unlike the habit of the hibernating forms the act takes place on the grape. The mating season for this brood extended into August. Since this was an unusually cool summer all the dates upon the activities of this insect after July 1 are from one to two weeks later than normal.

RELATION OF HIBERNATING PLACES TO LEAF-HOPPER INJURY.

That certain vineyards are more susceptible to attacks by the leaf-hopper is a common observation. The degree of infestation of vineyards is, however, not a matter of chance. Our studies

on the hibernating habits of the insect as previously noted showed plainly that situations in which dead weeds or grasses abound or where leaves from trees collect provided the best conditions for the wintering of the leaf-hoppers. Observations on the early movements of the insects in the spring also demonstrated that vineyards badly infested with this species were always adjacent to locations attractive for purposes of hibernation or where spring food-plants existed. The infestation of the grapes extended from such places outward across the vineyard. Fig. 2 is a sketch of a vineyard that presented a very unfavorable condition during the spring and early summer. It will be noted that the proximity of portions of the vineyard to grass fields, grassy headlands, wooded banks of a stream, blackberries, and raspberries determined the relative amount of leaf-hopper injury to the vines, as is indicated by the shading. This vineyard had been allowed to produce considerable weeds and summer grasses during the previous season and for that reason the insects were found throughout the area, but the portions having the greatest infestation were always adjoining situations that provided favorable winter quarters and spring food plants. In fact most vineyards whose owners have systematically "cleaned up" adjacent weedy and neglected land were free from excessive injury at least until August and usually the entire summer. While it is true that the nymphs and adults of the summer brood inflict much injury, owing to numbers, considerable damage is done by the hibernating adults in the spring since they attack young foliage, causing yellowing of the leaves, which is very noticeable in some years. This injury takes place at a time when it is impossible to control the insects with sprays. This phase of the habits of the hibernating adults has not been emphasized sufficiently heretofore owing perhaps to the fact that spraying for the summer brood of the nymphs has been depended on to protect the vineyard. This damage to the young grape foliage by the adults is needless, however, and can largely be prevented by burning over the winter quarters of the insects, which will destroy the greater portion of them.

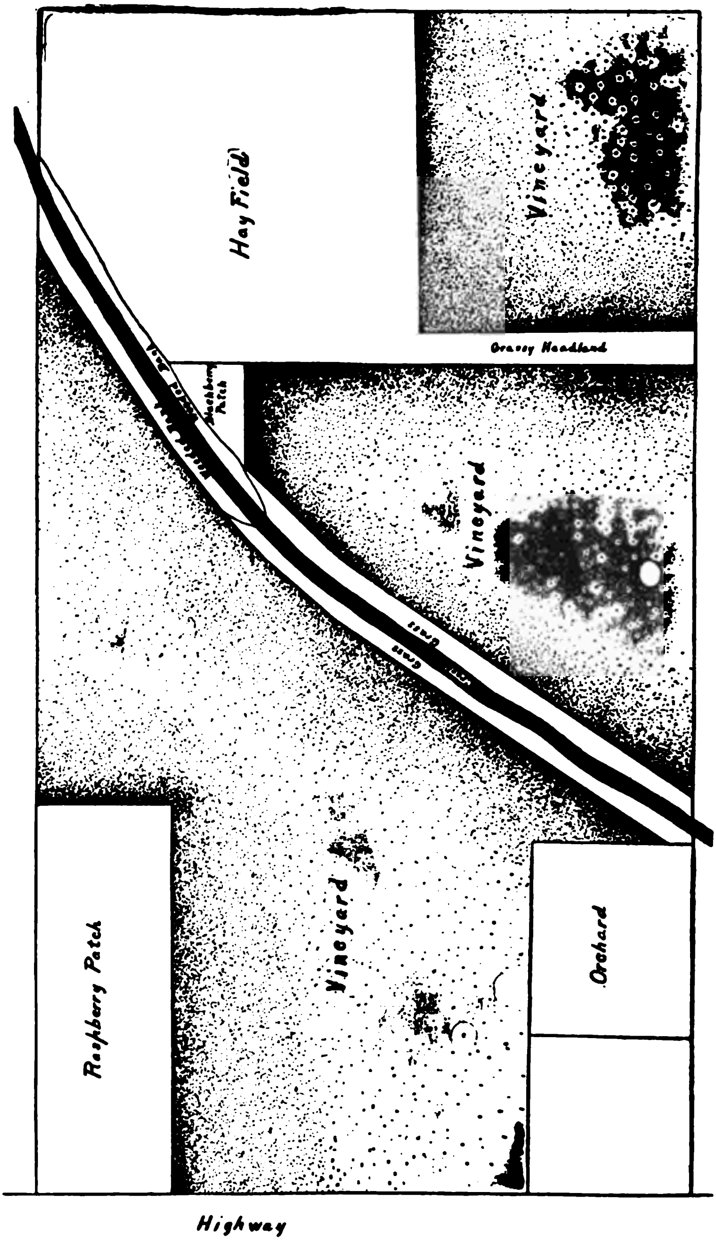

FIG. 17.—MAP OF VINEYARD AND SURROUNDINGS SHOWING THE RELATION OF FAVORABLE HIBERNATING PLACES AND SPRING FOOD PLANTS TO GRAPE LEAF-HOPPER INJURY.
(Amount of feeding in the vineyard indicated by depth of shading.)

EARLY HABITS ON GRAPE VINES.

On migrating to the grape vines, the leaf-hoppers feed first on the lower leaves and shoots. This they may continue to do until the middle of July, although there is a general movement of the insects to the upper portions of the vines as the summer advances and the injured foliage below begins to die. Many eggs are deposited in the lower leaves, but as they become soiled and pitted with many dead areas they cease to be attractive to the insects, either for oviposition or for subsistence. The grape normally produces a quantity of shoots and foliage about its base. As it is considered good practice to remove these during the summer, the injury to such suckers is obviously less important than that to the leaves on canes that are allowed to remain and perform their normal functions for the entire summer.

The habit of this species to select first the lower portions of the grape vines may perhaps be accounted for by the fact that the under leaves are less subject to disturbance by the wind. During a storm the majority of the adults flit to grass or weeds or to dry lumps of earth but when the wind abates they return to their former haunts. A small percentage of the leaf-hoppers nevertheless remain on the vines, and they seem to be able to cling to the leaves even during storms when the wind velocity is high.

EXPERIMENTS FOR THE CONTROL OF GRAPE LEAF-HOPPER.

Experiments for the control of the grape leaf-hopper were made in a number of vineyards in various portions of the Grape Belt in Chautauqua county during 1912. These were co-operative experiments in which the growers furnished their own material but applied it under the author's direction. All applications were made by means of automatic grape leaf-hopper sprayers.*

* The automatic grape leaf-hopper sprayer mentioned is described in Geneva Bulletin No. 344, Feb., 1912. No spraying was done by means of trailing hose described in Geneva Bulletin No. 331 because of the successful working of the new attachment. In vineyards located on very steep hillsides, when the rows run across instead of up and down, it will be found difficult to use such an attachment and the trailing hose had better be substituted.

Experiments were made in the Experimental Vineyard at Fredonia and in the vineyards of the following men: Nicholas Feinen, George O'Brian, Fredonia; J. Dunham, Brocton; M. B. Jillson and A. Freeling, Westfield; and W. M. Kingsley, Ripley. The conditions of the different tests will be discussed separately.

M. B. JILLSON VINEYARD.

This vineyard, near Westfield, was the most severely infested of any in which experiments were conducted. This was due to the location of favorable hibernating places in and about the vineyard and the proximity of spring food plants. (Fig. 2.) The hibernating quarters of the insect were found to be the wooded banks of a stream, a blackberry patch, a raspberry patch, and grassland; and many leaf-hoppers also passed the winter in the shelter of the summer grass which the former owner had allowed to grow as a natural cover crop in the vineyard the previous year. When first reported the hoppers were already on the grape foliage in great numbers, where their feeding punctures had caused large areas of the lower leaves to turn brown. Fortunately they were feeding on the lower leaves and therefore "suckering" was delayed until just before spraying. This kept the leaf-hoppers low on the vines and allowed the more permanent foliage to mature the crop. The lower shoots in this vineyard were removed during the second week of July and spraying was commenced on July 15 and continued until the 17th. Only one application was made, using "Black Leaf 40" in the proportions of one part to sixteen hundred parts of water. In certain portions where the root-worm was present in considerable numbers arsenate of lead was used with the nicotine. As a result of the spraying most of the nymphs were killed and the few that remained did not seriously affect the vines. Comparison of the foliage of this vineyard with adjoining plantings during September and October showed that these hitherto badly-infested vines which had poor prospects during the spring had more green

foliage and better fruit than those of neighboring vineyards which had a better outlook early in the season but which were not sprayed. The chemical analyses of fruit from sprayed and unsprayed vines in the same vineyard are shown in Table I.

J. DUNHAM VINEYARD.

This vineyard was near Brocton. Several portions of it were more severely infested than others. Here the importance of destroying the hibernating places was shown; for the severest injury in this planting always occurred in areas adjoining situations which offered shelter to the insects during the winter. It should be said that, for the season, this was only a moderately-infested vineyard. Spraying was done on July 15 to 17 and " Black Leaf 40 " was used with bordeaux mixture. The nymphs were killed and the foliage remained green. This vineyard was surrounded by others which were not sprayed, and during September it stood like an island of green in a sea of yellow. The effect of the treatment on the fruit is shown in Table I.

A. FREELING VINEYARD.

The effect of proximity of spring food-plants and favorable winter quarters was clearly shown in this vineyard, which was at Westfield. Cultivated raspberries were the food plants, while grassland aided in sheltering the insects. The vines were severely infested and were sprayed on July 16 and 17, and one application only of nicotine extract was made. The foliage of the sprayed vines remained green longer than that of the unsprayed ones and the difference in quality of the fruit will be noted in the analyses. Table I.

N. FEINEN AND G. O'BRIAN VINEYARDS.

Since these two vineyards, at Fredonia, are similarly located and were in all respects alike so far as the control of the leafhopper is concerned, the spraying operations are considered as one experiment. The sources of infestation were grassland and

PLATE IX.—GRAPE FOLIAGE WHEN "HOPPER" MIGRATION TO VINES IS GREATEST.

fence rows. The number of insects present was considerable. Spraying with nicotine extract was done in the Feinen vineyard on July 18–19 and in the O'Brian vineyard on July 22–23. At this time many of the nymphs were in the fourth and fifth instars, but the spray material was effective against them as was shown by the difference in the conditions of the foliage and fruit in sprayed and unsprayed areas. Table I.

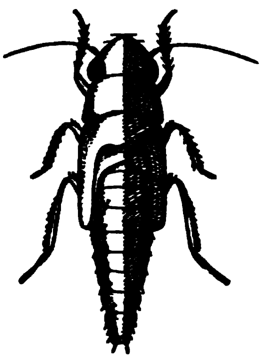

FIG. 18.—NYMPH OF GRAPE LEAF-HOPPER. (Fifth instar; enlarged.)

M. W. KINGSLEY VINEYARD.

The leaf-hopper and the grape berry-moth (*Polychrosis viteana*), were present in this vineyard, at Ripley, so the problem was more complicated than in the other experiments, as an effort was made to control both pests with the same spraying. The application was planned for the third week in July since the eggs of the moth were present on the grape berries at that time; but the breaking of the sprayer and unfavorable weather conditions delayed operations until July 27. The spraying was completed by the 30th. This delay in the treatment gave opportunity for a few of the hoppers to develop to adults but the majority of them consisted of nymphs of the fourth and fifth instars. The material used was arsenate of lead 6 lbs., "Black Leaf 40" ½ pint, whale-oil soap 3 lbs., water 100 gallons. The soap was used primarily as a so-called "sticker" which might more correctly be called a "spreader" for the arsenate of lead, but it is believed to have added to the efficiency of the nicotine in killing the leaf-hoppers for they were controlled very effectually notwithstanding the fact that they consisted largely of the older nymphs. The eggs of the grape berry-moth fortunately did not hatch before the spraying, owing to the cool wet weather during the latter part of July, so that the treatment proved effective also against the larvæ of this pest.

EXPERIMENTAL VINEYARD.

Owing to line fences, along which were growing many bushes, besides weeds and grass (Plate IV, figs. 1-3), large numbers of leaf-hoppers went into hibernation during the autumn of 1911 along the margins of the vineyard. As these vines are grown for various experimental purposes, all of them were sprayed with nicotine extract to control the insects since it was not desirable to leave checks. However, careful observations were made to note the effects of the treatment on the pest, which showed that the vines were efficiently protected by the spraying. Unfortunately there was in this planting considerable winter-injury, which caused the vines to appear as if they were damaged by the leaf-hopper, a condition quite prevalent in this region and not generally understood. Thus the vines as a whole did not present the uniform dark green appearance found in most of the other vineyards in which experiments were made.

RELATION OF LEAF-HOPPER INJURY TO QUALITY OF FRUIT.

The destruction of leaf tissue by the feeding of these insects causes a decreased wood growth which in time must affect the crop, but by far the most important loss to the grape-growers arises from a depreciation in the quality of the fruit. Concord grapes normally have a bluish-black color when ripened, but fruit from leaf-hopper-infested vines has a red appearance * and a decided

* In this connection it is important to add a word of caution. The fact that a Concord grape has a red appearance and is poor in quality is not conclusive evidence that the condition was caused by grape leaf-hopper. A peculiar vine trouble, resembling leaf-hopper injury, was of common occurrence in the vineyards of Chautauqua county. This trouble can be distinguished from insect injury in several ways: (1) It affects vines which have not been infested with grape leaf-hoppers; (2) The grape leaf-hopper punctures the epidermis or skin of the leaf and close examination will show distinct yellowish areas uniformly over the leaves caused by the feeding wounds. The ribs of the leaf have a yellow, punctuated appearance. If the leaf dies it will be found to die along the veins as quickly as on the margins. On the other hand vines having "leaf blight" (?) show leaves having darkened areas along the veins and the margins yellow and die first. It is important that every vineyardist distinguish between the injuries, for failure to do so has caused the waste of spray materials.

lack of flavor. Grapes affected by this insect show a decrease in sugar and an increase in acid — two important factors in determining the quality of the product. In order to have exact data showing the effects of injuries to the vines by this pest upon the quality of the fruit, chemical analyses* were made of grapes taken from sprayed and unsprayed vines, which are given in Table I. For the reasons given below, comparisons of the analyses can only be made as indicated — sample 3 with sample 5, 4 with 6, etc.

It should be noted in these analyses: (1) That every sample of Concord from a sprayed section gave a gain in sugar over its mate from the adjoining unsprayed section. These increases varied from 8.4 per ct. to 68.1 per ct., an average of 27.0 per ct. The two samples of Clinton grapes varied only 2.8 per ct.

(2) That in every sample of unsprayed grapes except one (Samples 7 and 8 which gave the same amount), the amount of acid was greater than in the corresponding sample from a sprayed vine. The excess of acid in the unsprayed grapes as compared with those sprayed varied from 0 per ct. to 20.6 per ct., an average of 11.2 per ct.

(3) Grapes from the upper portion of a vine gave a higher percentage of sugar than grapes from the lower portion of the same vine; on one vine the upper clusters showed 16.3 per ct. more

* These analyses were made by Mr. O. B. Winter, through the courtesy of Dr. L. L. Van Slyke of the Department of Chemistry of this Station. The taking of the samples received most careful attention, for unless care is exercised in the selection of the fruit the data secured are worthless. For example, analyses of two samples, one from upper portion and the other from the lower portion of the same vine (Samples Nos. 20 and 21) show a difference of sugar content, the grapes from the upper portion having 16.3 per ct. more sugar than the grapes from the lower portion. Samples Nos. 22 and 23 from another vine on clay soil but poorly ripened show a difference of 9.7 per ct. in sugar. In taking samples, two vines were selected that represented the *average* of the plat at that place, from the same soil, of the same age and variety, the one sprayed, the other unsprayed; an eight-pound basket of fruit was picked from each, care being taken to select the fruit uniformly from all portions of the vine; and duplicate samples were usually obtained from another portion of the same vineyard. With all these precautions small errors will undoubtedly occur in judging what constitute *average* vines, but the selection of a number of samples, all of which give similar results, should be fairly conclusive evidence that the data are reasonably accurate.

TABLE I.— CHEMICAL ANALYSES OF GRAPES: SPRAYED AND UNSPRAYED; OR ON UPPER AND LOWER PORTIONS OF VINES.
(Samples 17 and 19, Clinton; others Concord.)

No. of sample.	Vineyard.	Condition.	Description of fruit.	Amount of juice.	Brix reading.	Specific gravity.	Amount in 100 c.c. of juice of — Reducing sugar.	Amount in 100 c.c. of juice of — Total acid as tartaric.	Increase of sugar in sprayed grapes.	Increase of acid in unsprayed grapes.
				Cc.			Grams.	Grams.	Per ct.	Per ct.
5	Palmer	S*	Well ripened; berries fair size; color purple.	1,405	15.4	1.062	13.19	1.04	43.7	....
3	Palmer	N*	Poorly ripened; berries small; color red.	1,370	13.7	1.056	9.18	1.08	....	3.8
6	Palmer	S	Well ripened; color dark	778	14.7	1.059	14.10	1.13	23.4	....
4	Palmer	N	Poorly ripened; color red	1,345	14.1	1.057	11.41	1.18	....	4.4
7†	Jillson	S	Well ripened; cluster good; color dark.	755	17.7	1.072	13.48	1.23	8.4	....
8†	Jillson	N	Fairly ripened; cluster fair; red tinge.	775	17.6	1.071	12.43	1.23	....	0.0
9	Freeling	S	Well ripened; purple	750	18.4	1.075	14.45	1.04	16.3	....
11	Freeling	N	Poorly ripened; red	760	14.8	1.059	12.42	1.22	....	17.3
10	Freeling	S	Well ripened; purple	800	18.8	1.078	13.79	1.03	16.1	....
12	Freeling	N	Poorly ripened; red	770	16.0	1.065	11.87	1.21	....	17.5
15	Dunham	S	Well ripened; purple	745	17.5	1.070	13.41	1.07	68.1	....
14	Dunham	N	Poorly ripened; red	1,600	11.2	1.045	7.98	1.29	....	20.6
18†	Feinen	S	Well ripened; purple	1,255	17.3	1.070	13.43	1.01	13.0	....
16†	Feinen	N	Fairly ripe; red tint	1,270	17.0	1.066	11.89	1.16	....	14.8

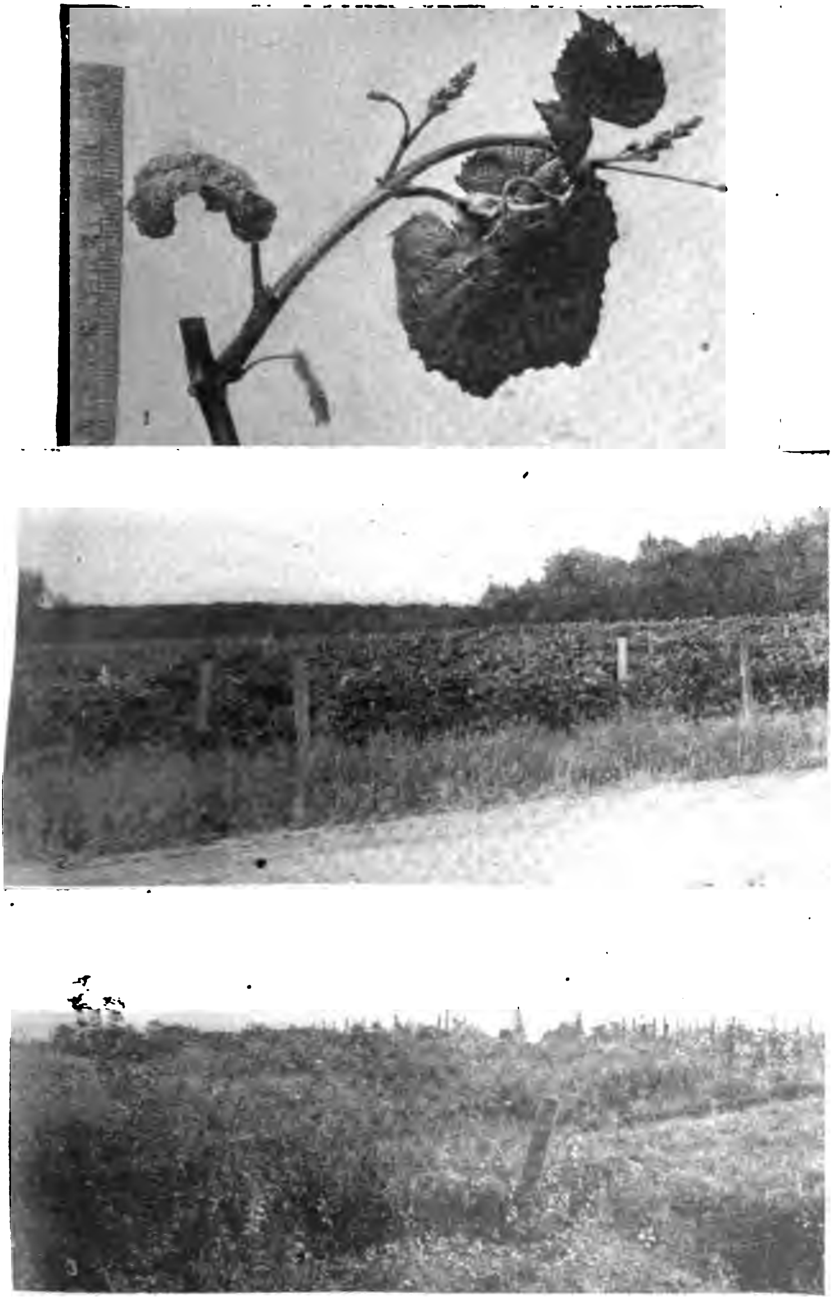

PLATE VIII.—GRAPE FOLIAGE WHEN FEEDING BY GRAPE LEAF-HOPPERS BEGINS; REFUGES OF "HOPPERS." (See page 300.)

sugar than the lower one and on another vine the difference was 9.7 per ct.

(4) The amount of acid was greater in grapes from the lower portions of the vine than from the upper portion of the same vine.

CONCLUSIONS DEDUCED FROM THE EXPERIMENTS.

These experiments were designed to test out the recommendations given in previous bulletins.* The Station has now conducted experiments for three years with nicotine extract, and two years with the automatic leaf-hopper sprayer. From the work done during these years the following points should be noted:

(1) Nicotine at the rate of .02 of one per ct. either in water or bordeaux mixture is an effective insecticide against the nymphs of the grape leaf-hopper.

(2) During three seasons there has been no burning of the grape foliage by the nicotine sulphate or nicotine in other forms used in our experiments; nor has the taste of nicotine been found on ripe grapes.

(3) Although it is necessary to combat the pest during its nymphal existence there is considerable time during which effective spraying can be done. The operations during 1912 covered a period of 15 days or half a month; but during years with hot weather during July the transformations are more rapid and ten days would be a safer margin for effective work.

(4) The automatic grape leaf-hopper sprayer has given satisfaction in the hands of careful grape growers. Carelessness in driving will bend or even break the booms, but with an average amount of care no trouble has been experienced with the attachment. Several manufacturers have attached the contrivance to their spraying machines, which gave satisfactory results, when pumps worked properly.

(5) Grapes from vines protected from leaf-hoppers had a higher percentage of sugar and less acid, and were of a darker color than grapes grown under identical conditions but subjected to the attacks of the insects.

* New York Agrl. Expt. Sta. Buls. Nos. 331 and 344.

(6) The destruction of the hibernating places by removing dead grass, leaves, bushes and rubbish assists greatly in reducing injuries by the grape leaf-hoppers and during ordinary seasons this measure alone will hold the pest in check. During seasons when the insects are superabundant, the grower should supplement this practice by spraying.

(7) Delaying the removal of the shoots at the base of the vine, "suckering," until just previous to spraying has helped to protect the more permanent foliage and thus aided the maturing of the fruit.

THE FALSE TARNISHED PLANT-BUG AS A PEAR PEST.*

P. J. PARROTT AND H. E. HODGKISS.

SUMMARY.

During some seasons, pears in New York are affected by a diseased condition characterized by the cracking open of the skin in small spots and the formation of protruding granular areas. Fruits seriously injured are usually much deformed and undersized. The nature and habits of the causal agent appears to have been little understood or not definitely known.

Recent investigations by this Station have demonstrated that the injuries to pears are largely caused by a true sucking plant-bug (*Lygus invitus* Say). The damage is done by the nymphs, which attack both pear fruit and foliage. Grape blossom clusters are also subject to attack. The adult is similar in appearance to the well-known tarnished plant-bug which thrives on a large variety of plants. The similarity in appearance of the adults of these two insects suggested as a common name, for the former species, false tarnished plant-bug.

The insect has five nymphal stages. The nymphs of the first two instars are pale, fragile creatures which are very active and subsist largely on the juices of the tender foliage. In the older stages they are more sedentary and attack both leaves and fruits. The habit of feeding in rather restricted areas is responsible for serious injuries to young pears. The destructive activities of the insects occur during the period coincidental with the conclusion of pollination and the formation of the fruit.

Tests during the past three years have demonstrated that spraying as blossoms drop largely prevents the deformation of the young pears. The spraying mixture that is recommended is three-fourths of a pint of tobacco extract (40 per ct. nicotine) to one hundred gallons of water to which are added three pounds of dissolved soap. Thorough applications, using liberal quantities of the spray, are essential to accomplish the desired purpose.

* Reprint of Bulletin No. 368, November, 1913; for Popular Edition, see p. 771.

INTRODUCTION.

During some seasons pears in different orchards in New York are much disfigured with rough and hard corky spots, and are, besides, liable to be considerably deformed. From the character of the injuries it has always been suspected that the miscreant was an hemipteron but the species seems not to have been positively known. In 1908 the work of the insect was so prevalent that it was decided by this Station to be a problem worthy of investigation, and steps were then taken to ascertain the identity of the offender and to develop, on the basis of life-history studies, a satisfactory method of control. This study has been continued each year, but progress in the knowledge of the insect has been disappointingly slow because of the elusive habits of the adult and its sensitiveness under confinement for purposes of observation. However, in spite of these difficulties the essential facts of its life history, especially those bearing on the stages most vulnerable to treatment, have to a large degree been obtained; and because of the interest in the work of the pest, which proves to be a plant-bug (*Lygus invitus* Say), it seems best to publish the data we have secured. It is hoped at some future time to supply some of the details of the late-summer habits of the adult which have so far escaped our attention.

ECONOMIC NOTES ON PEST.

EARLY ACCOUNTS OF INJURIES TO PEARS.

While this insect has doubtless caused losses of varying degrees of importance for many years and its destructiveness has been noticed by numerous growers, public attention seems to have been first attracted to the plant-bug by the nursery firm of Ellwanger and Barry[1] Rochester, N. Y. In 1884 they observed injured young pears and some insects upon them. Specimens of both were sent to the State Entomologist, Dr. J. A. Lintner, who made the following report: "Some of the pears of about one-half inch in diameter show as many as forty blotches from an eighth of an inch in diameter downward. From the minute puncture originally made the juice as it has escaped has become hardened and granulated and with its increase in size has split the skin in different directions, often in a

[1] Rept. Inj. Ins. N. Y. 3:110. 1885 (1886).

triangular form, or one wound running into another. The more seriously injured pears would be rendered unfit for sale from their knotted surface, even if after such a drain upon them they should continue upon the tree, which is not at all probable.

"The insects taken upon the injured fruit were the tarnished plant-bug (*Lygus lineolaris* (*pratensis* L.). Although they were not actually observed feeding upon the juices, there can be no reasonable doubt of their being the authors of the injury. This form of attack upon the fruit has not been previously recorded, yet their fondness for the blossoms of the pear is known, and they are also known to be destructive to the fruit of the strawberry." In this attack the insect appeared to exhibit a preference for the fruit of the variety Angouleme, while Anjou and other varieties seemed to be exempt from injuries.

In 1888 Mr. Barry[2] of the foregoing firm observed newly-set pears that were severely attacked by casebearers (*Coleophora* sp.) The injury consisted of numerous small holes in the surface of the fruit which caused them to become gnarled. The detection of this attack was considered by Lintner as the explanation of many of the scars and unsightly deformations of apples and pears which heretofore he had not been able to refer to any known insect. In July of the same year pears similarly scarred were received by him from Mr. J. F. Rose of South Byron.[3] The injuries were described as follows: "Some of the spots retained their original round form, while others had become elongated, triangular, lozenge-shaped or of irregular forms as a result of the growth of the fruit. The margins of the scars were blackened, elevated, and the somewhat enlarged interior contained pale, yellowish, granulated matter. From twenty to thirty of the scars occurred on each pear and several of the same character on the stems." In an accompanying footnote a portion of the injury was attributed to the plant-bug *Lygus invitus* Say.

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[2]Rept. Inj. Ins. N. Y. 7:347. 1890 (1891).

[3]In our correspondence with Mr. Rose we have learned that in 1891 he actually conducted a series of experiments for Lintner to determine the species of insect responsible for knotty pears. As the petals were dropping from the young fruits he covered a number of clusters of pears with very fine netting and introduced into these cages some plant-bugs which were observed to be very common on trees beginning to show deformed fruits. Pears attacked by the confined insects showed injuries similar to those which he had observed in his orchards during previous years. These "observations" on the work of *Lygus invitus* are apparently those mentioned by Lintner in his report for 1891.

In 1895 the experiments were repeated by him for Slingerland with similar results

In his report for 1891 Lintner[4] again gives an account of the attack on young pears at Rochester in which the "fruit was completely ruined by the gnarling, knotting and deformation caused by the punctures and feeding of one of the plant-bugs, *Lygus pratensis* L." Mention is also made of similar injuries to pears by a closely-related species, *Lygus invitus* Say, in another locality. During this season some observations were made on the operations of the plant-bug on fruit, and on other of its activities. It is also stated that while the work of this latter insect is quite general it is not often serious.

In 1893 Riley[5] recorded that an undetermined species of *Lygus* had caused injuries to young pears at South Byron, N. Y.

In 1895 Slingerland[6] called attention to "hard, knotty kernels (in pears) which are so often accompanied by irregular pustular spots or cracks" and "which were very prevalent in many pear orchards in western New York in 1894." The suggestion is made that these injuries are the work of plant-bugs or the plum curculio[7].

OBSERVATIONS AND EXPERIMENTS TO DETERMINE IDENTITY OF INSECT.

During the early summer of 1908 there were many complaints of deformed pears, especially from the region about Lockport. In an inspection of a number of orchards the injury was found to consist largely of the cracking open, in small areas, of the skin of the fruit, with the margins of the wounds slightly raised above the general surface, while the exposed tissues were of a hard, granular nature. The injuries, to all appearances, seemed to be identical with those described in the foregoing accounts. Attempts were made to discover the agent responsible for the damage in the hope that the culprit would be observed in the midst of his destructive activities. Repeated observations, however, failed to find an insect at work upon

[4] Rept. Inj. Ins. N. Y. 8:125. 1891 (1893).

[5] *Insect Life* 5:18. 1893.

[6] Cornell Expt. Sta. Bul. 93:221. 1895. (Footnote.)

[7] Through the courtesy of Prof. C. R. Crosby of Cornell University, we have been able since the preparation of the bulletin to examine Slingerland's notes and correspondence covering the earlier occurrences of this insect in New York. Among these there are records of injured fruit received by him during the period of 1895 to 1906 from South Byron, Spencerport, Lockport and Wyoming, which show that this insect had caused considerable injury to pears in certain orchards. It is also of interest to note that in his correspondence regarding this species a letter dated July 24, 1899, bears the memorandum "*Lygus* sp.?", and that another of July 17, 1906, is endorsed "*Lygus invitus*."

the fruit. Collections were made of the various insects upon th trees and the surrounding weeds and a large number of hemipterou species were obtained, among which *Lygus pratensis* L. was mos abundant. Individuals of this latter species were then confine separately about pears to determine if they were responsible for th injuries. While some of them punctured the fruit, none of th resulting wounds seemed to be quite like the injury to pears a apparent in the orchards, and the conclusion drawn from the test was that the destructive agent was some other species of insect

In the spring of 1909 a careful watch was maintained on a numbe of orchards that had been severely attacked during the precedin year, and on June 12 the flowing of sap from young fruits was observe by the authors in company with Mr. B. D. Van Buren of the Stat Bureau of Horticulture. A closer examination of the pears showe that a good many green hemipterous nymphs were present among th fruit clusters and were feeding upon the tender pears. Many of thes nymphs were collected, brought to the grounds of the Experimen Station and confined separately to young pears, which they immedi ately attacked. Those injured by the nymphs later became covere with hard, granulated spots which were indistinguishable from mucl of the damaged fruit which existed in orchards known to be infeste with the insect. From the nymphs, adults were obtained whicl were forwarded to Mr. E. P. Van Duzee for identification, wh determined the species as *Lygus invitus* Say. The foregoing obser vations and tests have been repeated in succeeding years, alway with the same results, so that the identity of the culprit and th nature of its activities, in view of the previous somewhat uncertai knowledge of the insect, may now safely be said to have been firml established.

FOOD PLANTS.

As has already been indicated, pears suffer most from the work o this insect, and judging from conditions in New York this frui appears to be its favorite cultivated host-plant. Uhler[8] mentions the occurrence of the insect on wild grape blossom clusters in Mary land, and young nymphs of this same species have been observed in considerable numbers among grape blossoms of native varieties growing about Geneva. This insect has also been occasionally

[8]*Proc. Bost. Soc. Nat. Hist.* 19:407. 1878.

found on the tender leaves of natural apples which have been intertwined with the wild grape. Dr. Forbes[9] notes a destructive attack by *invitus* on the young leaves of the common soft maple (*Acer saccharinum* L.) which caused them to curl and to become specked with numerous semi-transparent spots.

Dr. Howard[10] records also an injurious outbreak by this species on peaches in which the insect sucked the juices from the young fruits, causing them to shrivel. Similar injuries to peaches have been described by Lowe[11] which he attributed to *Lygus pratensis*. He observed, early in June, many of the insects upon young peaches, which they repeatedly punctured with their sharp bills. Drops of sap formed about the wounds, while the skin began to wither. The injured peaches, when mature, were deformed to a greater or less degree, depending upon the extent of the earlier injuries. From his account it is evident that he assumed that *pratensis* was responsible for the injuries; but owing to the great similarity of the two species there is a possibility that he failed to recognize *invitus*, a mistake that could easily occur. Unfortunately he made no collections of the insects, which would have settled any doubt as to their identity. His determination of the species is called into question as, thus far, by inspection of orchards where there have been abundance of nymphs and adults on surrounding weeds, we have not observed *pratensis* attacking peaches. By confining the adults in cages built about individual peaches the insects will, however, attack the fruit in a manner similar to that described above.

Besides the foregoing fruits, nymphs of *invitus* are of common occurrence on the young leaves of the sumach (*Rhus canadensis* Marsh).

NATURE OF INJURIES.

In its attacks on pears, *invitus* apparently shows a preference at first for the tender leaves, attacking those that are unrolled along the margins of the fold or those that are expanding at the apices or along the edges of the unfolded margins. (See Plate XI, fig. 1.) The tissues about the points of injury turn black, and if the punctures are numerous, more or less extensive areas along the margins of a leaf shrivel and become dry. The dead portions later become detached

[9] Rpt. St. Ent. Ill. 3:110-111. 1884 (1885).
[10] U. S. Dept. Agr. Bu. Ent. Bul. n. s. 30:98. 1901.
[11] N. Y. Expt. Sta. Bul. 180:135. 1900.

from the healthy tissues by the whipping of the wind, which may cause the affected foliage, usually on the growing shoots, to assume a ragged or frayed appearance.

The principal injury by this insect is the piercing of the young pears which later become much scarred and misshapen. The young nymph thrusts its proboscis deeply into the substance of the tiny pear and on withdrawing it sap flows from the puncture. The sap dries, leaving a blackish spot. (See Plate XI, figs. 2 and 3.) One nymph may make many wounds, and the perforations, which at first seem small and inconsequential, result in a disfiguration which becomes increasingly conspicuous as the young pear develops in size. (See Plate XII.) When the fruits have become as large as filberts they are conspicuously marked with hard, granular spots of irregular shapes, varying in size from a pin prick to one-quarter of an inch. Wherever they occur the epidermis is ruptured and uplifted while the exposed surfaces are mealy-like and of a light yellow color, contrasting strongly with the healthy tissues. (See Plate XIII.) By cutting into the fruit one will find hard, flinty areas which form cores in the flesh. When these are numerous the knife cuts with difficulty through them. Similar injuries may occur on the stems. Occasionally a number of the diseased spots may coalesce, producing a large crack which extends deeply into the flesh of the pear. Severely injured fruit, besides being badly deformed, may also be stunted in its growth, which may seriously affect its market value. (See Plate XIV.)

The Bartlett pear, which is one of the most desirable varieties, is especially subject to attack. The Angouleme has frequently, in some orchards, suffered to an equal degree. Other kinds susceptible to injuries are Clairgeau, Seckel and Kieffer. From this range of varieties it would appear that none of the leading sorts are likely to be exempt from injury.

This pest has for many years been very destructive in the orchard of Mr. S. Wright McCollum, Lockport, and in 1908, when our attention was called to its destructiveness in his plantings he estimated that 75 per ct. of the pears had been attacked, of which only 25 per ct. would, when mature, prove salable. The most injured specimens were picked off soon after the occurrence of the damages. The loss arising from the compulsory thinning of the crop was stated to be about five hundred bushels of pears, which does not

take in account the cost of labor involved in the operation. Much of the fruit left on the trees showed one or more of the characteristic scars of the insect, which detracted not a little from the general appearance of the crop.

Various references in literature indicate that the scars in pears, arising from the attacks of this pest, have been confused with the work of other species of insects. The injury by the cigar casebearer (*Coleophora fletcherella* Fern.) is in some respects quite similar, but it may be readily recognized by the fact that the initial wounds are round, which on healing preserve their original contour. (See Plate XV, fig. 2.) Other insects that frequently attack pears in New York are the plum curculio (*Conotrachelus nenuphar* Hbst.) and the green fruit-worm (*Xylina* sp.), which, however, produce very characteristic injuries. (See Plate XV, figs. 1 and 3.)

The work of the false tarnished plant-bug on grape is less conspicuous than on the foregoing fruit. The injuries to the foliage are quite similar to those on pears, and are most noticeable on the newly-unfolded leaves. Of a more serious nature are the attacks of the insects on the blossom clusters. The young nymphs pierce the bases of the unopened buds and the tender fruit stems. The wounds turn black, and if the feeding has been extensive the buds are checked in their development, and later drop, causing imperfect clusters of fruits. (See Plate XVI.)

In our study of *invitus* we have not observed it at work on peaches under natural conditions, but under confinement nymphs of the third and succeeding instars and adults readily attacked the fruit. To casual observers the first sign of the work of the older nymphs is the appearance of minute black points or specks on the surface of the pubescence, covering the skin of the fruit. A close examination of these areas will show that they are composed of discolored gummy exudations in which the hairs have become matted or glued together. In removing the pubescence from the points of discharge it will be found that the gum is rather strongly attached, and cannot usually be removed without injuring the surface of the fruit. The gum exudes from very small punctures in the epidermis of the peach, which are round or very slightly elongated. The margins of the perforations are hardened, but the callous areas do not extend below the skin, and yet they resist scraping. The gum first exudes in the form of a small globule, which is considerably larger than the puncture. The dis-

charge from the wound continues some time after the initial injury forming, especially under moist conditions, a narrow, thread-lik coil which may project a considerable distance from the surface of th fruit. (See Plate XVII.) As the peach grows the wound become more elongated, while the epidermis splits and becomes thickene and raised about the margins of the rupture. The flesh of the frui within the interior of the cut is soft and gummy. In the mor advanced stages the skin breaks diagonally across the injured areas which gives the scars a more or less square or rectangular appearance Later the skin rolls back, producing thickened margins about th wounds. Continued feeding in restricted areas results in the injure spots running together, which oftentimes forms large, elongate scars. The exudation of the gum increases with the extent of th injury and always follows the pubescence to the surface, with whicl it becomes matted over an extended area on the face of the fruit During rains the gum disappears from the fruit, while in very dry weather the discharge from the wounds may be very much reduced With the adults under confinement there was no gumming of th fruit, which we have not been able to explain in view of the contrary observations previously mentioned.

BIOLOGY OF THE INSECT.

CLASSIFICATION.

The Capsidæ, or leaf-bugs, to which this species belongs, consti- tute a very large and important group of hemipterous insects, includ- ing some very injurious forms, such as the four-lined plant-bug (*Poecilocapsus lineatus* Fab.) and the tarnished plant-bug (*Lygus pratensis* L.) It is the largest family of the Heteroptera; and accord- ing to Dr. L. O. Howard[12] comprises more than one thousand species, of which two hundred and fifty or more inhabit the United States. They are slender and delicate creatures, with soft and flex- ible wing covers, thickened basally. These insects are largely plant feeders and thrive on vegetation of all kinds, frequently occurring in large numbers. Varying with the species, they attack flower, fruit, leaf, stem or twig, and as a result of their feeding habits there is usually a drying up of the surrounding tissues which may interrupt

[12]The Insect Book, p. 301. 1901.

the nourishment of the plant and cause serious harm. Some forms prey on other insects.

The species under discussion was described by Say[13] in 1831, who named the insect *Capsus invitus* without giving its host-plant, which was apparently unknown to him. In 1878 Uhler[14] redescribed the species from one of Say's type specimens, placing it in the genus *Lygus*, and the insect is now known to naturalists as *Lygus invitus* Say. It has not so far received a popular name, but on account of its injurious habits and importance as a fruit pest the suggestion is made that it be popularly called the false tarnished plant-bug, which seems to be appropriate because of its great similarity to a closely-related and well-known form, the destructive tarnished plant-bug (*Lygus pratensis* L.)

DESCRIPTION OF LIFE STAGES.

Egg.—The egg is smooth and cylindrical as represented in Fig. 19. It measures about .8 mm. in length and .21 mm. in width. It is described in detail as follows: cylindrical; elongated; base rather bluntly rounded; lateral margins slightly swollen, strongly curved near the apex on one side, opposite margin strongly indented near apex to form a broad neck, which is surmounted by a narrow collar somewhat wider than the neck; apex of egg flat, elliptical in cross section. *Chorion*, clear; translucent; very delicate; coarsely punctured. *Cap*, coarsely punctured; whitish; opaque. *Collar*, whitish; opaque. *Color*, yellowish white, translucent.[15]

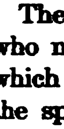

FIG. 19.—EGG.

Nymph.—The nymphs are small pale creatures in the first two stages and green in the third, fourth and fifth instars. In all stages they have the same general form which changes only in size and with the appearance of wing pads in the last three stages.[16] The measurements of the several instars are as follows: *1st instar*, .85 mm. long—.37 mm. wide; *2nd instar*, 1.18 mm. long—.42 mm. wide; *3rd instar*, 2-2.5 mm. long—1.03 mm. wide; *4th instar*, 3-3.25 mm. long—1.3 mm. wide; *5th instar*, 4-4.4 mm. long—1.5 mm. wide.

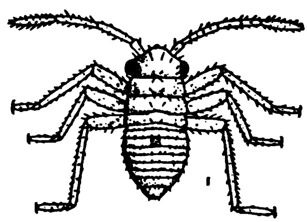

FIG. 20.—FIRST STAGE NYMPH.

The technical description of each of the nymphal stages follows:

First Instar.—Body, small; ovate-oblong; lateral margins narrowest behind the eyes, gradually widening with minor indentations to the fourth abdominal segment. *Abdomen*, pyriform. *Head*, large; triangular; broadly rounded at the apex, narrowing behind the eyes; eyes compound; integument smooth, with numerous small hairs

[13] Ent. of N. Am. 1:345. 1891. Le Conte ed.

[14] *Proc. Bost. Soc. Nat. Hist.* 19:407. 1878.

[15] The egg of *pratensis* differs chiefly in size. It is slightly larger and the chorion is more delicately sculptured. Length, about 1.02 mm.; width, about .27 mm.

[16] The nymphs of *pratensis* are small yellowish creatures in the first two stages. The larvae of the third, fourth and fifth stages are greenish in color, and may be distinguished from the young forms of *invitus* by five more or less distinct black spots upon the back.

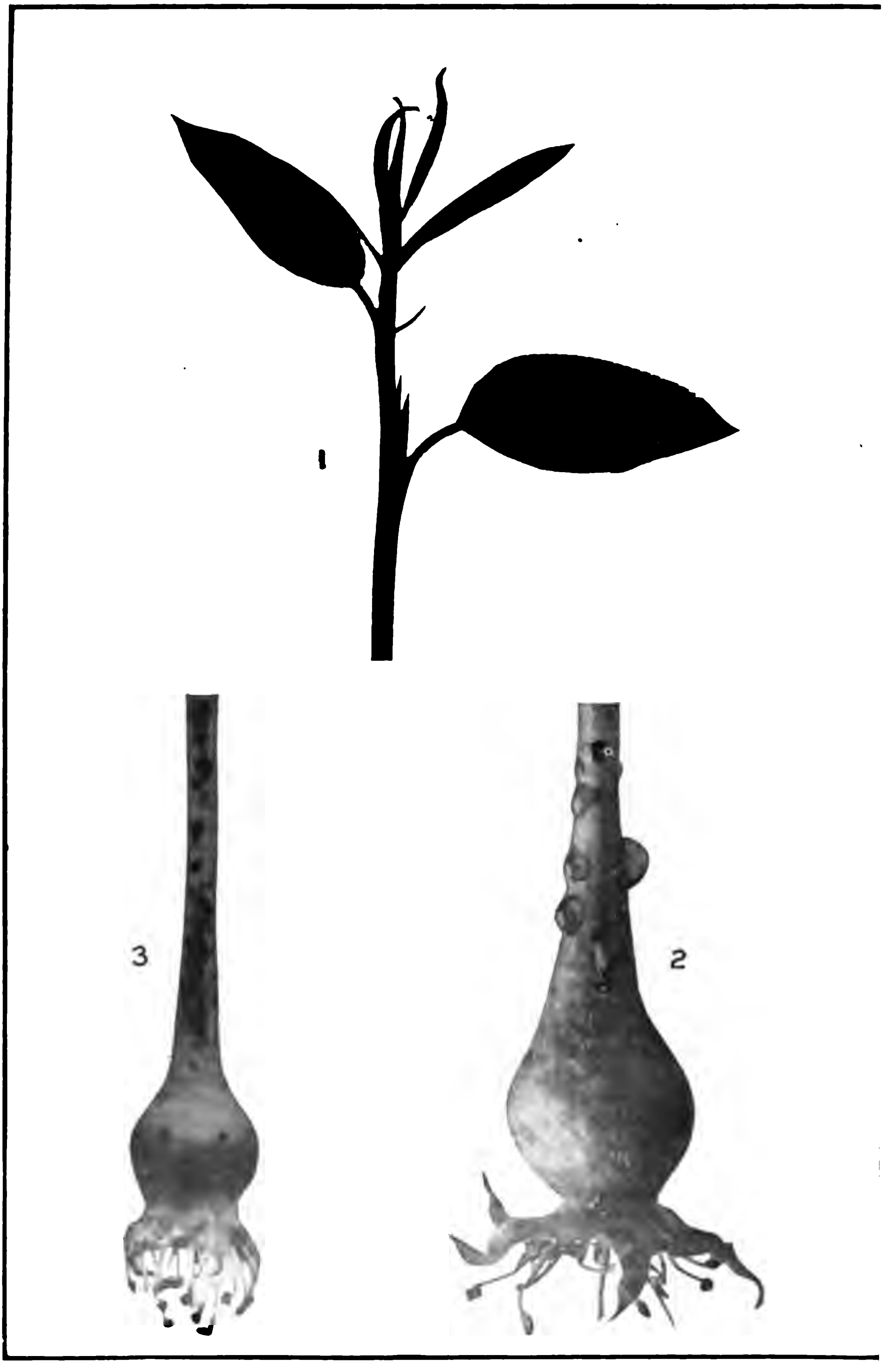

PLATE XI.— INJURIES TO YOUNG FOLIAGE AND FRUITS BY FEEDING OF *Lygus invitus*.

Plate XIII.— Collection of Fruits Injured by *Lygus invitus*.

PLATE XIV.— MATURE PEAR FRUIT DEFORMED BY *Lygus invitus*.

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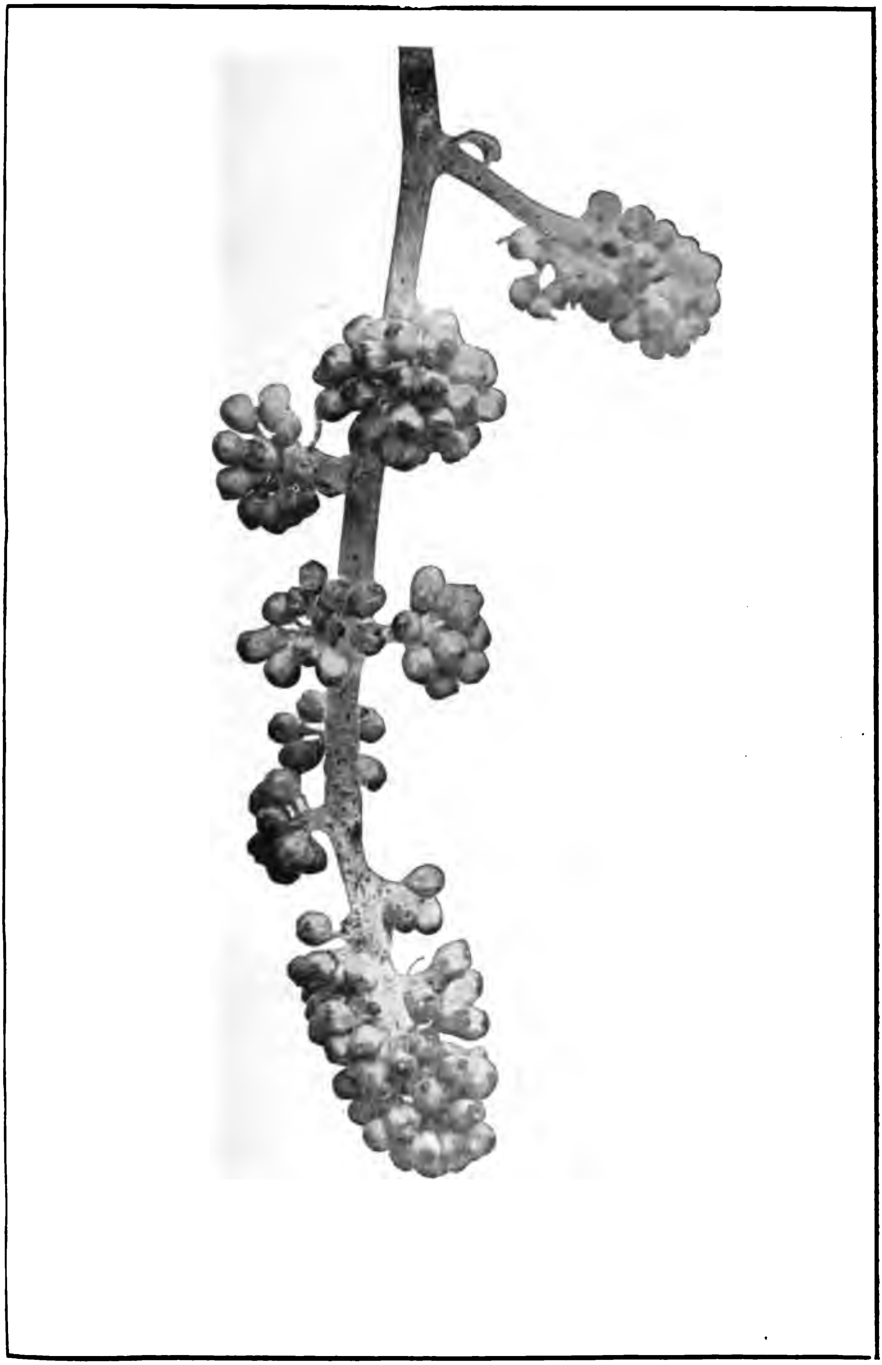

PLATE XVI.— GRAPE FRUIT STEM SHOWING PUNCTURES BY FEEDING OF *Lygus invitus*.

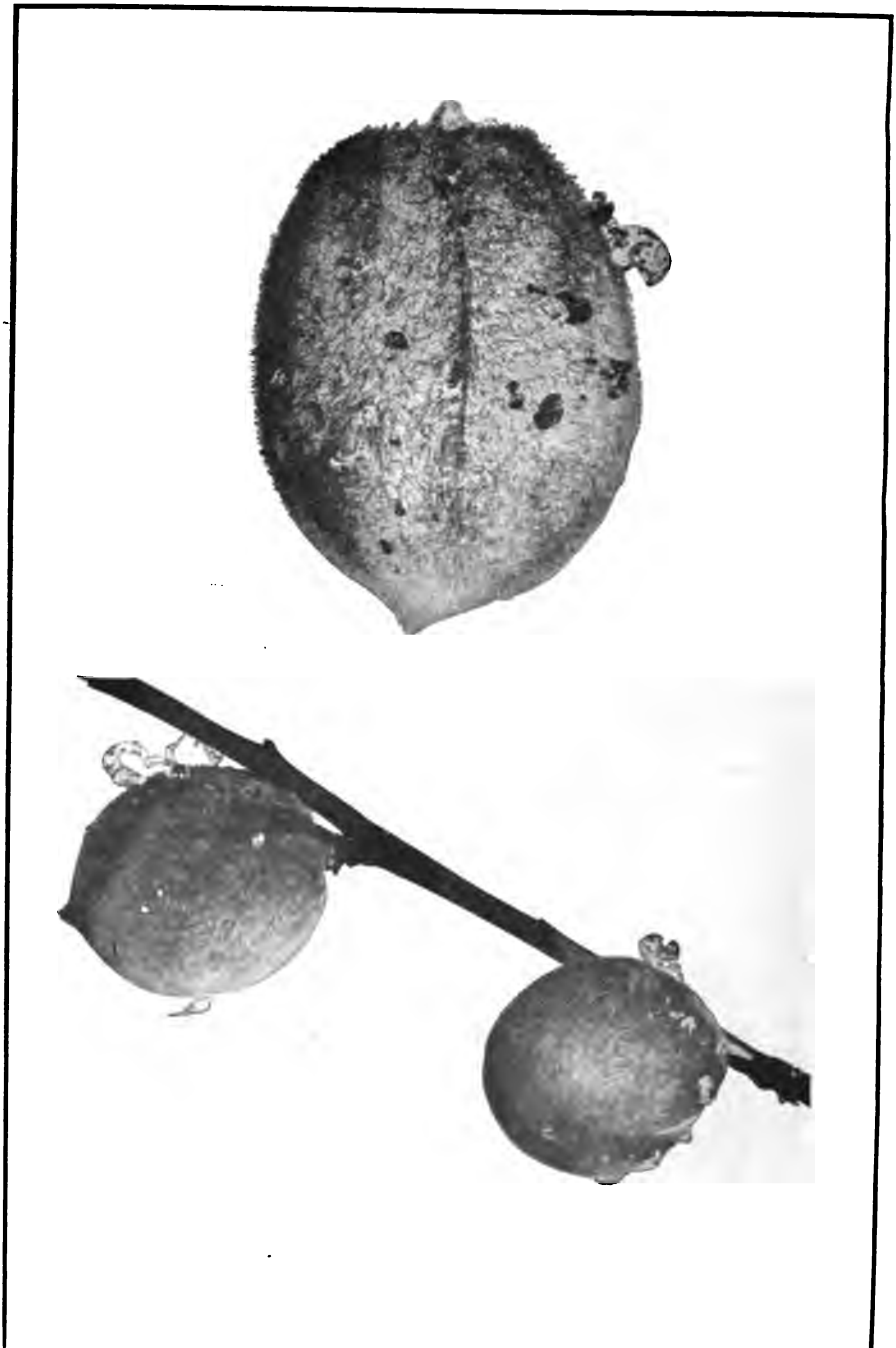

Plate XVII.—Peach Fruits Injured by *Lygus invitus*, in Breeding Cages.

fourth longer. The second tarsal joint of legs I is shorter, and on legs III is longer than on legs II. Claws, strong and recurved. Stout hairs arise in rows on the body and appendages, and other smaller hairs are irregularly placed.

Color, pale yellow; sometimes a tinge of green about the thorax; an orange-yellow spot occurs on the median of the third abdominal segment. Segmented appendages pale.[18]

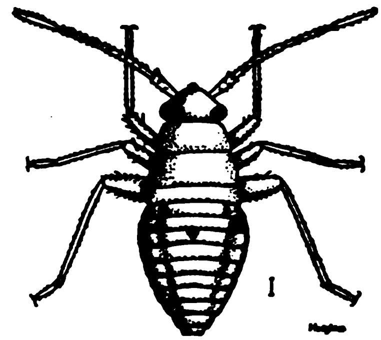

FIG. 22.—THIRD STAGE NYMPH.

Third Instar.—*Body*, of medium size; elongate-oval; broad; long; lateral margins narrowest behind the eyes; lateral thoracic margins almost parallel. *Abdomen*, as wide as thorax to third segment; gently tapering behind. *Head*, quadrangular; flattened at the front margin; lateral margins diverging widely at the eyes. Eyes compound, extending beyond the head. A number of hairs are regularly placed transversely in rows on the several portions of the body and its appendages. Integument covered with microscopic hairs.

Prothorax, very slightly shorter than the head; narrowest behind the eyes; widening to the posterior lateral angles, which are sub-angular; hind margin slightly wider than the transverse diameter of the head through the eyes. Mesothorax, about one-third wider and one-seventh longer than the prothorax; narrower than the metathorax, anterior lateral angles curved; posterior lateral angles strongly curved, projecting considerably beyond the hind margin of the segment. Metathorax, one-eighth wider than the mesothorax and three times the length of prothorax; hind margin strongly curved, posterior lateral angles extending slightly caudad.

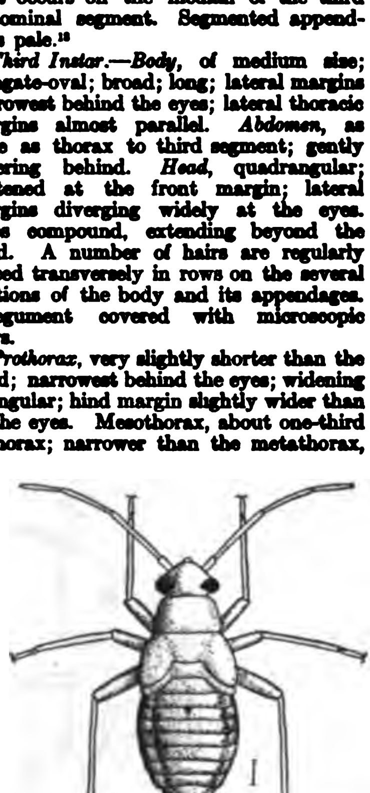

FIG. 23.—FOURTH STAGE NYMPH.

Appendages.—*Antennæ*, strong; first joint about one-half the length of the third, the second article about two and one-half times the length of the first; the fourth is less than twice the length of the basal joint. *Legs*, long and slender; femora III, one-third longer than femora I and somewhat longer than the second pair. Tibiæ I about one-third shorter than tibiæ II, which are two-thirds as long as tibiæ III. Tarsal joints, proportionately longer than in the previous stages. Hairs, situated on the body and appendages as in previous stages; they are relatively smaller in size.

Color, pale green with a yellow spot on the median of the third abdominal segment. Eyes dark red. Margins of thoracic segments with a yellowish tinge.[19]

[18] *Pratensis* nymphs of the second stage are broader and have a median abdominal spot similar in position and color to the preceding instar. The prothorax is but slightly longer than the mesothorax. The apical article of the antennæ is the longest.

[19] At the third instar *pratensis* is strongly green in color. On the pro- and metathorax are four small black spots situated on either side of the median. The thorax is more rectangular than that of *invitus* and the head is more angular. The third and fourth antennal joints are about equal. The legs are strikingly banded and suffused with reddish brown.

Fourth Instar.—Body, larger; elongate-ovate; broad and long. Lateral margins narrowest behind the head, gradually widening to the third segment of the abdomen, then abruptly to the anus. Integument microscopically hairy. *Abdomen*, pyriform. *Head*, small; quadrangular, lateral margins rather sharply converging at apex. Eyes compound. Hairs regularly placed as in previous instars.

FIG. 23a.—*L. pratensis*, FOURTH STAGE.

Prothorax, equal to the head in length; sub-rectangular; lateral margins only slightly divergent; hind margin somewhat wider than the transverse diameter of the head through the eyes. Mesothorax, about one-half longer than the prothorax; slightly wider than the metathorax; lateral angles projecting nearly to the second abdominal segment. Metathorax, somewhat longer and narrower than the preceding segment; hind margin at the lateral angles reaching the middle of the second abdominal segment.

Appendages.—Antennæ, strong; joint I is about one-half the length of joint IV; joint III is four-fifths the length of joint II, which is the longest member. *Legs*, long and slender; femora of about the usual proportional length; femora III about one-fifth longer than femora I; tibiæ I about one-half the length of tibiæ III, which are about one-third longer than tibiæ II. The tarsi are as usual. Hairs on the body are placed as usual, but are somewhat smaller.

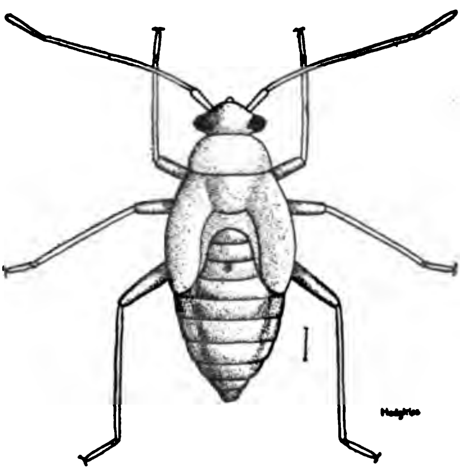

FIG. 24.—FIFTH STAGE NYMPH.

Color, green throughout; wing pads often lighter yellow; top of head, tips of wings and median abdominal spot yellowish.[20]

Fifth Instar.— Body, larger; elongate-oval; lateral margins narrowest behind the eyes, gently curved to caudal margins. *Mesothorax* and *abdomen* of about the same width. Hairs less noticeable than before. *Head*, small; subtriangular; base of proboscis causing outline to be acutely triangular; anterior margin flattened. Eyes extending beyond the head; compound. Integument, smooth; thickly covered with microscopic hairs.

Prothorax, longer than the head; broad; narrow; narrowest just behind the eyes; anterior lateral angles strongly rounded; posterior lateral angles sub-angulate. Mesothorax, somewhat wider and about four times as long as the prothorax; lateral margins straight; caudo-lateral angles produced, reaching the fifth abdominal segment. Metathorax, about the same width and length as the mesothorax.

[20] *Pratensis* differs in the fourth instar chiefly in its greater size, color and shape of the body. The thorax is strongly mottled and the five characteristic black spots are distinct. The pro- and meso-thorax are about equal in length. The third and fourth antennal joints are about equal in size. See Fig. 23a.

Appendages.—*Antennæ*, strong; basal segment less than one-third the length of joint II, which is somewhat longer than joint III; the apical segment is shorter than joint III. *Legs*, strong; femora I, shorter than femora II; femora III, slightly longer; tibiæ I and femora I are of about the same length, and only slightly shorter than tibiæ II, which are about three-fifths as long as tibiæ III. The tarsi are as usual. Hairs, somewhat less prominent than before.

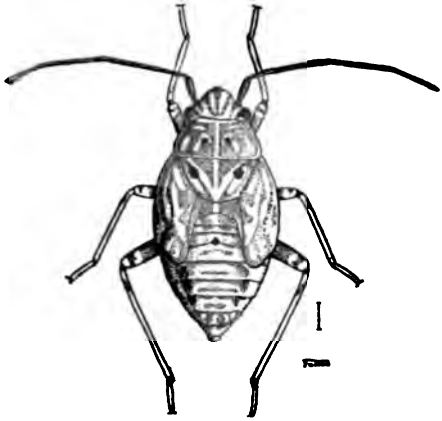

FIG. 24a.—*L. pratensis*, FIFTH STAGE.

Color, light green; eyes light colored. Margin of thorax, tips and margins of wings pale yellow. Wing pads often dark brown. Median abdominal spot pale yellow, sometimes indistinct.[a]

Adult.—The adult is a small, slender, delicate pale-green sucking insect at the time of emergence. The color tints on the wings soon appear and within a short time well-developed individuals become darkish brown. A considerable variation occurs in this respect, however, and adults may be either darkish brown, pale yellow, or some combination of these tints. The adult was described by Uhler[22] as follows: "Form of *Lygus contaminatus* H. Schf. Pale, obscure yellow; antennæ and transverse carina at base of head very slender, the former nearly as long as the hemelytra, the apical joint infuscated; surface of head polished, impunctured, clothed with short hairs; tylus slender, short; eyes brown, large, prominent. Pronotum smooth, very convex, sparingly hairy, finely, densely, mostly confluently punctured.

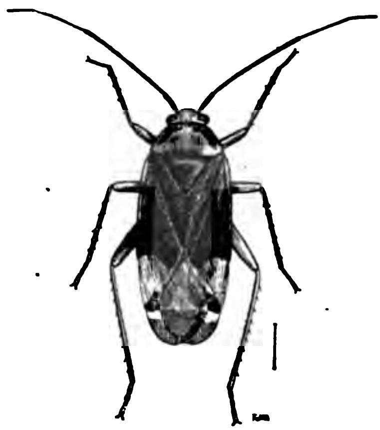

FIG. 25.—ADULT.

Scutellum moderately convex, brighter yellow, closely and finely wrinkled and punctured, minutely pubescent. Hemelytra closely covered with yellow prostrate pubescence, finely, closely, punctured; clavus embrowned, a brown cloud across the tip of the corium invading the base of the membrane. The membrane with a brown spot occupying the tip of the areole, behind this is a marginal smaller spot brown, and still farther back a smaller one; inferior surface and legs lighter yellow, the venter pubescent, shining,

[a]In the fifth stage, *pratensis* nymphs are of a dull green color mottled and marked with brown. The characteristic spots and the bands on the legs are distinct. The pro- and meso-thorax are of about equal length. The second antennal joint is the longest. See Fig. 24a.

[22]*Proc. Bost. Soc. Nat. Hist.* 19:407. 1878.

and more or less embrowned about the disk. Length to tip of hemelytra 6 millims. Humeral breadth, $1\frac{3}{4}$ millims."[23]

LIFE HISTORY.

As is common to insects of this group the nymph passes through five stages, attaining wings at the fifth ecdysis. The minute yellow larvæ make their appearance during the period when the trees are coming into blossom and until pollination is completed and the young fruits are of the size of filberts. The time for the emergence of the insects in their maximum numbers has, during the past several years, been largely coincidental with the dropping of the petals, but probably this will not hold true under all seasonal conditions. In 1910 hatching of eggs occurred during the period of May 3 to May 19, and in this interval the trees were in full bloom on May 5, and blossoms began to drop on May 9. In 1911 and 1912 pears blossomed on May 11 and 12 and

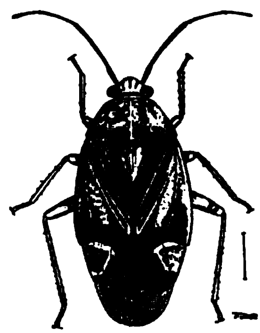

FIG. 25a.—*L. pratensis*, ADULT.

petals began to drop on May 15. During each year nymphs of the first instar were abundant at the later date, and within one week the insects, with hardly an exception, had transformed to the next stage. Nymphs of the second instar differ from the preceding stage chiefly in size and they appear in about one week after the eggs are hatched. In 1911 many of these nymphs were seen as late as May 31, while in 1912 they were becoming very abundant on May 22.

At the next ecdysis the young insects become green in color while the integument appears to be tougher and more horny than before. The nymphs from now on are less active and remain quietly upon the foliage or on the fruits for considerable periods of time. Specimens reared in the laboratory completed this instar in either 6 or 7 days.

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[23]The adult of *pratensis* is a small, oval, sucking insect about one-fifth of an inch in length. It differs from *invitus* in size, being slightly shorter, and in the angular contour of the head. The prothorax is prominent and the lateral margins of the wings are rounded. The color markings on the body and appendages are distinctive of this species. The general color is yellow or greenish yellow, more or less striped with dusky, while the scutellum is margined with ivory. On the other hand *invitus* is usually brown and lacks the marginal markings on the scutellum. See Fig. 25a.

These nymphs are the first to cause marked injuries, which is undoubtedly due to the increased size and the rather sedentary habits of the insects.

With the fourth instar the wing pads become more noticeable and the insects are of a much greater size. The color remains the same except that the margins of the thorax may be of a pale yellow tinge. The nymph is even less active than before and remains quiet unless suddenly jarred, when it quickly seeks a hiding place. The fourth instar was completed in the breeding cages in either 5 or 6 days. These nymphs were numerous in the pear orchards on June 8, 1912.

The fifth or last instar is completed in 6 days. The nymphs are large and the wing pads are considerably lengthened and have a dark brownish tinge. Individuals of this form were taken from pear trees on June 15, 1909. On June 8, 1912, nymphs of the fourth stage were collected, which molted on the following day and the fifth instar lasted until June 14.

The adult insects during the years of 1910-1912 appeared between June 6 and June 18. The adults remain on the trees amongst the succulent growth and on the pear fruits for a short time after emergence and then disappear. In the laboratory the mature insects lived on succulent tips of pears and fruits for about four weeks before they succumbed. In cages on bearing pear trees they lived as long as three weeks. The adults disappear by the middle of July and during the years of our study of this pest they have not been seen again in the orchards until the following season at the conclusion of the nymphal period.

HABITS.

The newly hatched nymphs are frail but very agile creatures. They at first seek the tender, unfolding leaves which they may puncture severely, and during periods of rest they may be found in the axils of the leaves or in the folds of leaves which are unrolling. When disturbed they quickly run to places of hiding. With the setting of the fruit they then direct their attacks upon the young pears. Especially attractive to them are clusters of fruits which are growing close together and have not reached such size that their weight pulls them apart. In these the insects find concealed positions and do much damage. On separating the fruits one may find half a dozen or more nymphs, while all of the young pears may be more or less

punctured, with globules of sap issuing from the wounds. The nymphs seem to show a preference for the tapering portion of the pear about the thickened stem, while older nymphs have been observed attacking the cheek, calyces and the calyx basin. A young nymph under confinement was observed to stab a tiny pear eight times in succession, which soon became wet with the sap exuding from the wounds. A clear, greenish fluid is also discharged from the anus by the nymphs and may at times be seen on the fruits in rather copious quantities.

The nymphs apparently show no preferences for situations for molting as their cast skins have been observed on leaf petioles, basal portions and upper and lower surfaces of the leaves, cheeks and calyx basins of the fruit. The adults for a short time after they make their appearance feed in a manner similar to the younger stages, but as they are very shy and quick to take alarm it has not been possible in the field to learn much of their habits. Under confinement in the breeding cages they succumbed within two or three weeks after emergence, notwithstanding they were given pear leaves and fruits on which to subsist.

On the grape the young nymphs puncture at first the unfolding leaves and later, when the blossom clusters appear, they secrete themselves amongst the young flower buds which they attack. The insects not only feed upon the young buds but they puncture also the peduncles and the pedicels of the unopened blossoms and immature berries.

During their later stages the nymphs are of much the same tint as the blossom clusters and as these increase in size the insects, because of color resemblance and opportunities for hiding, are able to pursue their activities effectively concealed from the ordinary observer. The adults feed for a short time after emergence, when they disappear.

CONDITIONS OF ORCHARDS FAVORING INJURY BY THE INSECT.

Woodland, shrubs and weeds along roadsides and fences afford very congenial surroundings for many insects. For certain species they are nothing less than veritable nurseries. In such situations the common tarnished plant-bug (*Lygus pratensis*) thrives. Because of its close relationship with the foregoing species and striking similarities in some of its habits, it has been suggested that the

proximity of weeds and brush to an orchard favor the propagation of *invitus* and encourage its presence on pear trees. With this point in mind a careful study has been made of a number of orchards subject to attack by this insect, but the evidence so far has been quite contradictory, as the following observations show.

In 1908 a few trees in one orchard were much infested with the false tarnished plant-bug, but the damage was practically confined to the sides of them that were nearest to considerable undergrowth or brush. The desirability of clean culture to destroy the origin of the infestation seemed plain, and this was put into practice. But in spite of this measure injuries to the fruit have continued to appear on the trees in the original area of infestation as well as in other portions of the orchard.

In another orchard the insect has caused more or less losses to the yields for a period of over twenty years, and since 1910 the planting has been very much neglected and is now grown to grass and weeds. For the past two seasons the crop has hardly been worth harvesting because of the work of *invitus*. Adjoining this orchard there is another planting of pears which is given careful cultivation, and the crop has now for two years been quite free of injury with the exception of the fruit taken from trees adjacent to a fence overgrown with weeds and brush.

In Orleans county there is an orchard which is close to a small belt of timber, and in 1911 all the trees for a width of several rows which were nearest to and parallel with the woods showed considerable injuries to the crop. In the more remote portion of the orchard deformed fruit occurred to only a slight extent.

Quite contradictory to the foregoing is the experience of Mr. S. Wright McCollum of Lockport. His pear orchards, three in number, are among the best managed plantings in Niagara county. Each year his crops are damaged by this insect, and during some seasons he has experienced severe losses. Originally *invitus* confined its attacks to a corner of one of his plantings which was near a row of wild berries and sod. Of late years, in spite of clean culture, the insect has spread throughout all the orchards and apparently has found in these plantings the essential conditions for its maintenance as a permanent pest.

From the present knowledge of its habits *invitus* breeds most abundantly on pears, wild grapes and sumach, and in all probability

it exists on other plants. Of those specially mentioned it propagates in largest numbers on wild grape and to a much less extent on sumach. Both are common and widely-distributed weeds. In spite of the conflicting nature of the above evidence as to the influence of clean culture upon the multiplication and spread of the insect, it would seem a good practice on the part of the grower to destroy both the wild grape and sumach even though this now appears as an extreme precautionary measure.

METHODS OF CONTROL.

SPRAYING.

As injury occurs within a short period after fruit has set the orchardist should examine his trees carefully, commencing with the dropping of the petals, to note conditions with respect to the nymphs. If they appear to be numerous he should resort to spraying to protect the crop. Taking one season with another, an application just after the blossoming period should afford adequate protection. Treatment should not be delayed until injuries commence to show on the young fruits. In the Station's spraying tests, tobacco extract (40 per ct. nicotine (Black Leaf 40), using three-fourths of a pint of the extract to one hundred gallons of water to which are added three pounds of soap) has given the most satisfactory results of the various mixtures which have been tried. In applying the spray the trees should be drenched, special pains being taken to wet both surfaces of the leaves. Some growers have combined the nicotine extract with dilute lime-sulphur containing arsenate of lead as applied for codling moth with equally satisfactory results on both insects and foliage and by this means avoided the necessity of an extra spraying. But as there is danger of burning pear foliage by drenching the trees with lime-sulphur, we would advise, as a general recommendation, a special treatment with nicotine and soap to combat this pest.

DESTRUCTION OF UNCULTIVATED HOST-PLANTS.

The fact that the insect breeds most abundantly on wild grapes and to a certain extent on sumach suggests the desirability of destroying these plants when they exist in the immediate vicinity of a pear orchard. As previously stated, the value of this operation is not known; but until there is more knowledge of the breeding habits

of the pest the removal of weeds that are attractive to the insect for purposes of propagation would appear advisable as a precautionary measure.

SOME ASSOCIATED INSECTS.

Associated with *invitus* in its attacks on the leaves and fruits of different hosts, we have found a number of other species of capsids which are briefly noted as a matter of record.

Lygidea mendax Reut.—Besides apples this species was quite abundant on pears and plums in an extensive planting of these fruits about Lockport. The nymphs confined their attacks principally to the succulent growth of the trees and did considerable injury to the young leaves.

Prof. C. R. Crosby has cited the occurrence of this insect on pear in Japan, and has described in detail its importance as an apple pest[24].

Campylomma verbasci Meyer.—This capsid in its various nymphal stages and as an adult attacks pear foliage and fruit in a manner quite similar to *Lygus invitus*. In our breeding work we reared the species through its successive instars along with the nymphs of *invitus*, not realizing that there was any contamination by a second species until the appearance of the fourth and fifth nymphal instars. Newly-hatched nymphs of this species were obtained on May 2 and adults appeared on May 20. The nymphs were very active creatures and fed on both foliage and fruit. Sap flowed quite profusely from the wounds in the young pears, but as our observations were confined to specimens in the laboratory we have not been able to determine the effects of the early work of this species on the mature fruit. Judging from the few individuals that we reared of *verbasci* as compared with *invitus* it would appear that this insect is only of slight economic importance.

The adult at emergence is pale greenish in color, and at that time is to be distinguished from *invitus* chiefly by numerous brownish spots on the legs. The mature insect has been described by Reuter[25] as follows:

"Under side of abdomen brown or jet black, upper surface greenish gray or dirty grayish white, shining, with long, golden yellow hairs which become brown in certain lights, and also a short, golden yellow pubescence; head, testaceous; clypeus, brownish

[24] Cornell Expt. Sta. Bul. 291. 1911.
[25] Hem. Gym. Eur. 1:53, 175. 1878.

black at the apical division; antennæ, with a black ring before the tip of segment I and at the base of article II; discoidal cell of corium often obsolete and the median spot brown; posterior femora with many black spots. Length 2¾ mm."

Paracalocoris colon Say.—The nymphs of this species were found feeding on succulent sprouts of Bartlett pears at Lockport. Collections of nymphs of the first two instars were made on May 14, 1912, at which time they were causing quite a little injury to the leaves. These nymphs were kept in cages on pear foliage and fruits until maturity, and their work on both proved to be quite similar to that of *Lygus invitus*. The effect of their early injuries on the mature fruit was not ascertained. Brief descriptions of nymphal stages and adult of this insect are given below:

First Instar.—Color, deep red, somewhat translucent. The head is wedge-shaped, eyes large, thorax narrower than head, twice as long as wide, abdomen pear-shaped, flattened caudad. Length 1 mm., width .5 mm.

Second Instar.—Color darker red than in the preceding stage. Head and thorax dark red, abdomen lighter, translucent; median of thorax white; first abdominal segment ivory white; antennæ, with terminal joint suffused at tip for two-fifths of its length, remainder ivory white; legs, reddish brown, translucent, white at tips of joints and tarsi; venter of abdomen red. In general shape this form is like the preceding stage.

Third Instar.—There is no change in the third stage except that the abdomen is more translucent.

Fourth Instar.—Abdomen and median of thorax lighter, almost greenish in color; greenish coloration noticeable to a less degree on the median of the thorax; head and eyes dark brown; basal article, anterior two-thirds of article II and anterior half of article III deeply colored with reddish brown; femora deeply colored except near the bases, which are lighter; tibiæ banded with the same color, the bands on the posterior pair being the wider.

The body is long, narrow; head acutely triangular and about twice the length of the thorax. Prothorax rectangular, sides strongly rounded. Mesothorax and metathorax of almost equal length with the wing pads produced strongly caudad. Abdomen long, pear-shaped. Body and appendages very hairy; most noticeable on the abdomen where the deep brownish color of the hairs contrasts strongly with the lighter coloration of the body. Length 3.99 mm., width 1.26 mm.

Fifth Instar.—The last stage nymph does not materially differ from the preceding stage except in length and size of wing pads.

Adult.—"Grayish; thorax with two black dots. Body brownish gray, with numerous short, yellowish hairs; antennæ, basal joint robust, narrowed at base, two-thirds the length of the second; second joint very slightly thicker at the tip, whitish in the middle and for a short space at the base, and blackish at tip, third and fourth joints as long as the first, whitish; thorax with a black orbicular dot each side of the middle; hemelytra with from three to five obsolete brownish spots on the corium and two or three on the membrane; beneath dusky, varied with yellowish lineations on each side of the venter; feet yellowish, thigh dusky at tip; tibia with about two dusky annulations. Length over one-fourth of an inch."[36]

This species, like many other capsids, is subject to variation. It is sometimes yellowish, variegated with brownish, but the thoracic orbicular spots and the annulations of the second joint of the antennæ distinguish it.

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[36]Ent. N. Am. 1:345. 1891. Le Conte ed.

Paracalocoris scrupeus Say. This species is commonly associated with *invitus* on wild grape, and during some seasons large numbers of the nymphs may be observed feeding on the tender leaves and blossom clusters of this plant. The injuries to grape blossoms and to the foliage are identical with both insects. The nymphs of *scrupeus* are readily distinguished from those of the foregoing species by the brownish bands on the antennæ and legs.

The nymphs of the third instar are slender, much like the young forms of *invitus* in shape and size. The thorax is more rectangular and the appendages are more slender. The antennæ are long and filiform. Color, pale green; abdomen concolorous with a median fuscous spot at the cephalad margin of segment IV. Eyes brown; anterior angles of prothorax fuscous; head and wing pads slightly suffused. Antennal article I, the distal half of article II, and the distal third of article III fuscous; the terminal joint is slightly suffused. Legs I, slightly suffused at distal end of femora; tibia with narrow fuscous bands near proximal end, slightly suffused at distal margin; distal tarsi deeply suffused. Legs II with similar markings more clearly defined. Legs III have in addition to these areas a median tibial fuscous band. Body thickly clothed with brown hairs.

In the succeeding stages the changes which occur are chiefly in the size, growth of the wing pads, and in the distinctness of the markings. The terminal antennal segment is much finer and nearly translucent. Legs II have a less distinct median tibial band.

Adult.—Body black; head with a dull yellowish line and superior orbits, variegated at the mouth and beneath: antennæ, first joint more than half the length of the second, and rather robust, hairy; second joint a little thicker at tip: thorax yellowish, anterior margin, two dots, and a slight dot near the posterior angles black; scutel yellowish, dusky on the middle of the base and on the basal angles: hemelytra immaculate: feet with minute pale points. Length to tip of hemelytra nearly one-fourth inch.[27]

A number of varieties of the adults transformed in the breeding cages. One of these has the thorax and scutel pale yellow; on another the thorax and scutel are bright orange; a third is fuscous in color with the median of the scutel bright orange-red for two-thirds of its length.

[27]Ent. N. Am. 1:342. 1891. Le Conte ed.

ZINC ARSENITE AS AN INSECTICIDE.*

W. J. SCHOENE.

SUMMARY.

This is a report of a series of experiments with zinc arsenite and lead arsenate to determine their relative toxicity to insects and the safeness of zinc arsenite for use on foliage.

One pound of zinc arsenite proved equal in effectiveness to three pounds of lead arsenate.

Zinc arsenite when added to calcium hydrate or bordeaux mixture caused no injury to apple foliage; but more or less spotting of apple leaves occurred when the poison was used singly or in combination with lime-sulphur or glucose. Zinc arsenite alone or with glucose caused severe burning of grape foliage. Laboratory tests suggest that the injury to foliage by zinc arsenite may be due in part to the solubility of the poison in carbonic acid.

The contradictory results from the use of zinc arsenite on foliage suggest that the poison as manufactured is not a stable or uniform product.

Zinc arsenite or lead arsenate with bordeaux, soap or glue continued effective for twenty-five days. Either of the poisons alone or with glucose gradually lost its poisonous properties on exposure to weather and by the end of this period had ceased to protect the foliage.

Incidental to the main problem it appears in these tests that the lime-sulphur solution does not resist wet weather as well as bordeaux mixture.

INTRODUCTION.

Zinc arsenite has recently been introduced as an insecticide and has been advertised for sale in this State. The chief advantages claimed for the poison are that it has a high arsenical content and is in a form readily available to insects. On the basis of the prevailing market prices it is, besides, more economical than arsenate of lead, which at the present is largely used in spraying operations against leaf-eating and fruit-eating insects. The experiments herein reported were planned to determine by field and laboratory tests its rate of action as compared with arsenate of lead, and its safeness

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for use on foliage; and to ascertain its relative adhesive qualities under ordinary weather conditions.

PREVIOUS REPORTS ON ZINC ARSENITE.

Luther[1] states that in the Pajaro Valley, California, zinc arsenite can be used with safety on the foliage of apple, potato and bean, but not on peach. Woodworth[2] in speaking of spraying operations in the same region says that "this [zinc arsenite] has proven to be the safest of the arsenicals that can be procured in the form of a dry powder" and that "there is no doubt that the zinc arsenite stands foremost at the present time among the available arsenicals with high arsenic content." Swingle and Morris[3] in a study of bark injury to fruit trees caused by arsenicals state that "zinc arsenite (ortho) gave practically no injury under the most severe conditions of the tests . . . ". Cooley[4] reports its successful use against the potato beetle (*Leptinotarsa decemlineata* Say), the larva of the European cabbage butterfly (*Pieris rapæ* L.) and the diamond-back moth (*Plutella maculipennis* Curt.), without injury to the foliage of potato or cabbage. Johnston[5] reports favorable results in a potato-spraying experiment carried on in cooperation with the Virginia Truck Experiment Station. In marked contrast to the above accounts is the report of Britton[6] to the effect that two sprayings at an interval of seven days using three-fourths of a pound of ortho zinc arsenite to fifty gallons of water were followed by severe injury to apple, which caused about one-half of the leaves to drop. Volck[7] recommends the substitution of zinc arsenite for arsenate of lead in the first two sprayings for the codling moth and he further states that "zinc arsenite . . . may cause foliage injury if not properly handled. When mixed with iron sulphide the foliage-injuring properties are largely restrained, and several applications may be made [to apple]. When no iron sulphide is used only the first (full bloom) spraying should be applied with this arsenical." Gillette[8] says that during 1911 zinc arsenite was used by a number of fruit growers on the western slope and no damage resulted except from a single lot of the poison. He suggests that the zinc arsenite manufactured is perhaps not of uniform quality. Melander[9] says that in his tests zinc arsenite has not caused injury to the foliage of apple.

[1] *Better Fruit*, 5, No. 8: 65–66. 1911.
[2] *Better Fruit*, 5, No. 8: 70. 1911.
[3] *Phytopathology*, 1: 93. 1911.
[4] *Jour. Econ. Ent.*, 5: 142–6. 1912.
[5] U. S. Dept. Agr. Ent. Bul. 109, pp. 53–65. 1912.
[6] Conn. State Exp. Sta. Ann. Rept. 1911, p. 358.
[7] *Better Fruit*, 6, No. 11: 46–47. 1912.
[8] Letter of June 19, 1912.
[9] *Better Fruit*, 6, No. 12: 13. 1912.

STATION EXPERIMENTS WITH ZINC ARSENITE.

CONDITIONS OF THE EXPERIMENTS.

Tests to determine the effects of weather on zinc arsenite and its safeness for use on foliage were conducted in the field while most of the feeding tests were performed in the laboratory under conditions that made it possible to observe closely the behavior of the poison upon the insects. The feeding tests were made by supplying sprayed foliage to a definite number of insects enclosed in cages. The leaves and twigs used in most of these experiments were sprayed in the laboratory with an aspirator. To determine the lasting properties of the mixtures when exposed to weather, trees were sprayed in the field from which at intervals foliage was removed and fed to insects. If there was only a small consumption of foliage the amount of feeding of the insects was estimated in square centimeters, but if the amount consumed was large it was approximated and designated by such terms as moderate, extensive, etc.

In addition to these laboratory studies, field tests were made in the Station nursery and orchard by spraying trees upon which the insects were already established, to compare the action of the poisons on host and parasite under out-of-doors conditions. To each fifty gallons of the diluted spray mixture one of the poisons was added as follows: zinc arsenite one pound, lead arsenate (paste) three pounds, or lead arsenate (dry) one and one-half pounds. The zinc arsenite contained 40.28 per ct. arsenious oxide, and the arsenate of lead paste 17.75 per ct. arsenic oxide.[1]

Determinations were made of the solubility of zinc arsenite in tap water, distilled water and dilute carbonated water. One series of analyses was conducted according to the official method employed to determine the water-soluble arsenic of paris green, which is done by shaking one gram of the sample in one thousand cubic centimeters of water eight times a day for ten days. The second series of analyses was similar to the above except that the shaking continued for a shorter time. The results are shown in the following table:

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[1] The arsenious and arsenic oxides are not entirely comparable as they are different compounds and probably do not have the same toxic values. It would appear from the experiments described later that as an insect poison .40 lb. arsenious oxide was roughly equivalent to .53 lb. arsenic oxide. There are two other facts about arsenites in general that should be taken into consideration in view of the variable results in the use of zinc arsenite secured by different workers: (1) Arsenites in general are not so stable as the arsenates; and (2) all arsenites usually retain some arsenious oxide so that it is difficult to obtain definite compounds.

Through the courtesy of Dr. L. L. Van Slyke and Mr. E. L. Baker, the moisture determinations of the poisons were made by Mr. Otto McCreary and the analyses by Mr. A. W. Clark.

Solubility of Zinc Arsenite as Indicated by the Water-Soluble Arsenious Oxide.

	Shaken ten days.	Shaken one day.	Shaken one hour.
	Per ct.	*Per ct.*	*Per ct.*
Tap water	.50	....	.50
Distilled water	.75	....	.62
Carbonated water	....	9.67	8.16

The microscopic appearance of the particular lots of the two poisons used in these experiments was as follows: The particles of lead arsenate paste were non-crystalline, roughly spherical and ranged in size from one to three microns. The particles of zinc arsenite were slightly elongated, the shortest diameter being about the same as that of the arsenate of lead.

The materials employed in these tests were used in the following quantities in fifty gallons of the diluted spray: lime-sulphur one and one-fourth gallons of a solution testing 33° Beaumé, bordeaux mixture containing four pounds of copper sulphate and four pounds of quicklime, soap two pounds, furniture glue one pound, glucose twenty-two pounds and quicklime three pounds.

The precipitation record at Geneva, N. Y., covering the period of July 30 to August 24, when tests were conducted in the field, is as follows:

Date.	Rainfall in inches.	
July 31	.06	
Aug. 2	.07	
" 3	.03	
" 5	.08	Total to Aug. 7, .24 inches.
" 10	.44	
" 12	.08	
" 15	.07	
" 18	.65	
" 19	.24	
" 20	.04	
" 21	.03	
" 23	.09	Total to Aug. 24, 1.88 inches.

LABORATORY FEEDING TESTS.

Test No. 1, with Lina scripta.— This test was designed to determine the effects of zinc arsenite and arsenate of lead with and without molasses. The beetles were confined in cages and supplied with sprayed willow foliage. The observations were continued for nine days.

Results.— There was no marked difference in the speed of action of the different combinations with the exception of the zinc arsenite and molasses. With this preparation 60 per ct. of the beetles succumbed within twenty-four hours, while with the other mixtures no insects died until the second or third day. After this period usually one or two of each lot would be found dead every day. A moderate amount of feeding occurred during the first twenty-four hours, then the beetles ceased to feed and remained inactive, as if hibernating, until death ensued.

Test No. 2, with Mamestra picta.— In this test, the purpose was to determine the effects of zinc arsenite and lead arsenate alone or in combination with either sugar, soap or glue. As the insects had been taken on cabbage, seedlings of this plant were used as food. The observations were continued for four days.

Results.— No appreciable difference was detected in the rate of action of the arsenicals on this species. It should be mentioned that neither sugar, soap nor glue influenced materially the effectiveness of the poisons. The toxic properties of the zinc and sugar combination were shown in twenty-four hours by the death of one larva, while the poisonous effects of the other mixtures were not apparent until forty hours. Notwithstanding these differences at the start, all the combinations were practically of equal effectiveness at the expiration of four days.

Test No. 3, with Hyphantria cunea, was made to determine the comparative values of the following combinations: lead arsenate, paste, with water, soap, glucose and glue; lead arsenate, dry, with water, bordeaux and lime-sulphur; and zinc arsenite with water, bordeaux, lime-sulphur, soap, glucose and glue. Trees in the nursery were sprayed with these mixtures and on the same day some foliage of each was brought to the laboratory and fed to the caterpillars. The rate of action of the different mixtures and the relative consumption of food is indicated in Table I.

Results.— Attention is called in this experiment to the similarity in action of the poisons and the irregular amount and character of feeding. However, considering both the appearance of the caterpillars at the end of the test and the number killed, there is a slight difference in favor of the zinc combinations. The maximum feeding occurred with zinc arsenite, zinc arsenite and glue, and lead arsenate and glucose. The minimum amount of foliage was consumed where mixtures of lime-sulphur or bordeaux with either poison had been applied. These results indicate a greater repellent action by the last-named combinations. This repellent property was apparent also in the manner of feeding, for check larvæ fed from the upper surface, leaving the lower epidermis intact; while, as will be noted in the table, the larvæ in some experiments fed only from the under surface or ate holes in the leaf, consuming both the upper and lower epidermis.

Test No. 4, with Hyphantria cunea, was designed to determine the insecticidal values of mixtures after three days' exposure to weather. The sprays applied were lead arsenate, paste, with water, bordeaux, lime-sulphur, soap and glucose; and zinc arsenite with water, bordeaux, lime-sulphur, soap, glucose and lime. Trees in the orchard were sprayed on Aug. 14 and on Aug. 17 foliage was removed from the trees and fed to insects. The rate of action of the mixtures and the extent of feeding are shown in Table II.

Results.— There was very little difference in the rate of action of the poisons except when arsenate of lead was used in combination with lime-sulphur or glucose. These proved less effective, although the amount of foliage actually consumed was greater than with the other lots. This suggests that during the interval of three days' exposure the mixture of lead and lime-sulphur had lost some of its effective properties. The minimum feeding occurred when arsenate of lead was used alone or with bordeaux, and when zinc arsenite was used with lime or bordeaux mixture.

Test No. 5, with Hyphantria cunea.— This test is identical with No. 3 except that the sprayed trees were subjected to the weather for eight days. The trees were sprayed July 30 and the foliage fed to the insects on Aug. 7. As will be seen from the weather record, page 6, there occurred in this interval four showers aggregating, 24 inch.

Results.— All the sprays were still effective as insecticides, though the glucose with lead arsenate had lost some of its poisonous properties. In the eight days' exposure there was a partial loss of the repellent action of some sprays and generally much more feeding than in test No. 3. The minimum feeding occurred with lead arsenate and glue and with the combinations in which soap and bordeaux were used. The area of leaf surface consumed was at least three times greater with mixtures containing lime-sulphur than with mixtures containing bordeaux, which is a marked contrast to what occurred in Test 3. This indicates, as did other tests, that lime-sulphur loses its repellent properties sooner than the sprays that contain soap and bordeaux mixture. The maximum feeding occurred where either lead arsenate or zinc arsenite was used alone or in combination with glucose.

Test No. 6, with Hyphantria cunea.— This is similar to Nos. 3 and 5 except that the sprayed foliage used in this feeding test had been exposed to the weather for twenty-five days. The trees were sprayed July 30 and the foliage brought to the laboratory Aug. 24. The sprayed foliage used in this experiment had been subjected to the washing action of 1.88 inches of rain from twelve showers occurring during the interval.

Results.— The combinations that were still distinctly effective were those in which glue and bordeaux were used and the zinc arsenite and soap mixture. On the contrary, zinc arsenite, lead arsenate,

zinc arsenite with lime-sulphur and the combinations with glucose lost their effectiveness. The precipitation had washed off the evidence of spray from the foliage in all except the bordeaux treatments, which was correlated with more extensive feeding by the insects. This feeding was most abundant where glucose, lime-sulphur and lead arsenate were used, while the minimum feeding occurred with the bordeaux combinations and with the glue and lead arsenate and the soap and zinc arsenite.

FIELD FEEDING TESTS.

Some tests were made in the field to compare the effectiveness of zinc arsenite and arsenate of lead for the spiny elm caterpiller (*Vanessa antiopa*) and the larvæ of the willow beetle (*Lina scripta*).

Results.— The shape and size of the trees upon which the beetle larvæ were feeding prevented actual counts of the insects, but as near as could be determined the time required for effectiveness was practically the same for the two poisons, there being a lapse of four days before all the larvæ died. Opposed to this the results with the *Vanessa* larvæ were quite striking. The spiny elm caterpillars on the trees sprayed with zinc arsenite were all dead within twenty-six hours, at which time the insects on the tree sprayed with arsenate of lead showed no outward effects of the poison, though all succumbed in a period of four days. The experiments with the *Vanessa* larvæ were repeated in the field and in the laboratory with similar results.

Two explanations are suggested to account for this difference in the action of the poisons: *First*, that the zinc arsenite may be more soluble than the lead arsenate in the digestive secretions of these particular insects and that more time is required for the lead than the zinc poison to exert its toxic properties in the body. *Second*, that in drinking from the globules of spray as larvæ were observed to do, more of the zinc on account of its lower specific gravity [1] is actually conveyed into the digestive tract of the insects.

DISCUSSION OF RESULTS.

EFFECTS OF THE POISONS ON THE INSECTS.

In the experiments in which the treated twigs were fed to the insects as soon as the spray on the foliage had thoroughly dried, the effects of the two poisons were generally similar, although there was a slight difference in favor of the combinations containing zinc arsenite, which were quicker in action. The only marked difference between the two arsenicals as regards speed of poisoning was noted

[1] Mont. Exp. Sta. Bul. No. 86.

TABLE I.— TESTS OF KILLING EFFECT OF LEAD ARSENATE AND ZINC ARSENITE ON *Hyphantria cunea* ON APPLE FOLIAGE, GENEVA. Trees sprayed July 30 and foliage brought into laboratory on same day. Ten larvæ in each test. U = upper surface of leaf; L = lower surface; W = entire thickness of leaf; T = slight injury.

DATE OF OBSERVATIONS.	Paste Lead Arsenate in Combination With —				Dry Lead Arsenate in Combination With—			Dry Zinc Arsenite in Combination With —					
	Water.	Soap.	Glucose.	Glue.	Water.	Bordeaux.	Lime-sulphur.	Water.	Bordeaux.	Lime-sulphur.	Soap.	Glucose.	Glue.
Aug. 2 Number dead.....	0	0	0	0	0	0	0	0	0	0	1	1	0
Aug. 2 Foliage eaten, sq. cm.	2 U 2 W	5 U	12 U	5 U	½ U ½ L 5 W	3 U	1½ U	10 U	3 L	2 U	4 U ¾ W	3 c. m. W	10 U 10 W
Aug. 3 Number dead.....	0	0	0	0	0	0	0	0	2	0	0	0	0
Aug. 3 Foliage eaten, sq. cm.	2 U	1 cm.	10 U	2 U	1 W	T	—	10 U	1 U 1 L	T	1 U	T	T
Aug. 4 Number dead.....	0	0	0	0	0	0	0	0	0	0	1	1	0
Aug. 4 Foliage eaten.	T	T	4 U	T	T	—	—	T	—	—	T	T	—
Aug. 5 Number dead.....	0	2	0	0	0	0	3	0	0	1	0	1	0
Aug. 5 Foliage eaten.	T	—	T	T	—	—	T	—	—	—	—	—	—
Aug. 6 Number dead.....	1	2	2	2	0	1	0	0	0	0	0	1	1
Aug. 6 Foliage eaten.	T	—	—	—	T	—	T	T	—	—	—	—	—
Aug. 8 Number dead.....	5	5	5	5	8	4	2	6	7	8	2	4	6
Aug. 8 Foliage eaten.	—	—	—	—	—	—	—	—	—	—	—	—	—
No. alive at end of test....	4	*0	3	3	2	†3	*4	4	1	1	*5	2	3
Total area of leaf eaten.	6 U 2 W	6 U 1 W	26 U	7 U 1 L	7 W ½ U ½ L	4 U 1½ W	2 U 1½ W	20 U 4 W	1 U 4 L	3½ U	6 W	4 cm.	10 U 10 W

* One larva parasitized. † Two larvæ parasitized.

TABLE II.— TESTS OF KILLING EFFECT OF LEAD ARSENATE AND ZINC ARSENITE ON *Hyphantria cunea* ON APPLE FOLIAGE SUBJECT TO THE WEATHER.

Trees sprayed Aug. 14 and foliage brought into the laboratory Aug. 17. Twelve larvæ in each test. T = small amount of leaf eaten; M = much injury to leaf; A = whole leaf eaten.

DATE OF OBSERVATION.		PASTE ARSENATE OF LEAD IN COMBINATION WITH —					DRY ZINC ARSENITE IN COMBINATION WITH —						Check.
		Water.	Bor-deaux.	Lime-sul-phur.	Soap.	Glucose, 22–50.	Water.	Bor-deaux.	Lime-sul-phur.	Soap.	Glucose, 22–50.	Lime.	
Aug. 20	Number dead	0	1	1	1	1	0	1	0	0	1	1	0
	Sq. cm. of leaf consumed	4 cm.	3 cm.	16 cm.	10 cm.	17 cm.	7 cm.	5 cm.	11 cm.	7 cm.	10 cm.	4 cm.	25 cm.
Aug. 22	Number dead	3	3	3	2	1	1	1	2	1	4	2	0
	Sq. cm. of leaf eaten	T	—	T	T	T	T	T	T	T	—	T	M
Aug. 24	Number dead	0	4	0	2	0	0	4	1	1	2	0	0
	Sq. cm. of leaf consumed	T	—	T	T	T	T	—	—	—	—	—	A
Aug. 26	Number dead	5	3	2	7	4	9	5	8	9	5	9	0
	Sq. cm. of leaf consumed	—	—	T	—	—	—	—	—	—	—	—	—
Alive at end of test		*3	1	*5	0	6	2	*0	1	1	0	0	12
Total feeding		4 cm.	4 cm.	16 cm.	11 cm.	20 cm.	7 cm.	6 cm.	12 cm.	7 cm.	10 cm.	4 cm.	—

* One larva parasitized.

when caterpillars were on the foliage at the time of treatment or placed on the tree when the leaves were still wet with the spray mixture. In this case applications of zinc arsenite showed their deadly effects upon the caterpillars much sooner than those containing lead arsenate.

As a rule the insects on freshly-sprayed foliage ate only one meal and thereafter fed very little until death ensued or the experiment was concluded. In all cases the amount consumed in the initial meal was greater with the check than with any of the sprayed plants, indicating that either there was a reaction by the insect to the poison or that the spray possessed distasteful or repellent properties. In the tests in which foliage that had been exposed to the weather was fed to insects the period of feeding was more extended, depending on the interval between treatment and the feeding of the insects. The caterpillars which were given foliage that had been exposed for twenty-five days fed voraciously for three to six days before the poison became effective.[1]

EFFECT OF WEATHERING ON EFFICIENCY OF SPRAYS.

The effects of weather on the insecticidal properties of applications of the poisons are shown in Tests 3, 4, 5 and 6. The period of exposure of the sprayed foliage was three hours, three days, eight days and twenty-five days respectively. See Chart I, (p. 16).

All sprays were practically equal in effectiveness when first applied, but exposure to weather tended to reduce their insecticidal properties. In these experiments the preparations that contained bordeaux, soap or glue in combination with either of the poisons and the lime-sulphur combined with dry lead arsenate continued effective as insecticides for twenty-five days. Zinc arsenite or arsenate of lead alone or with glucose ceased to protect the foliage from insects at the conclusion of this period.

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[1] The effect of arsenic upon the higher animals and man depends upon the size and form of the dose administered and the condition of the subject. According to Blyth (Poisons: Effects and Detection, pp. 494–543. 1884) a large dose results in an acute case. The symptoms usually appear within an hour and may be accompanied by vomiting and diarrhœa, death following in from 3 to 24 hours. The symptoms resulting from a milder dose are much the same, though death may not occur for a longer period. Where the dose is very mild the ordinary vomiting and purging are much suppressed and instead jaundice, narcotic sleep or partial paralysis may result. These symptoms may be followed by death or the subject may recover after an illness varying from a few days to several months. The behavior of poisoned animals corresponds very well with that of the insects under observation. The caterpillars which were supposed to have received a large dose were affected with a severe diarrhœa and died within 20 to 30 hours. Some individuals were apparently affected more than others, judging from the interval between feeding and death. In other tests the insects became inactive, some ceased to feed, others would nibble here and there until death ensued; while many of the larvæ after one meal of poisoned foliage showed symptoms of starvation, becoming less active, with an apparent drying of the body.

All of the sprays were distinctly repellent at first. On exposure to weather some sprays lost their distasteful or repellent properties much sooner than others. The mixtures containing bordeaux, soap and glue were repellent to the end of the test, covering a period of twenty-five days. As opposed to this the poisons when used alone or with lime-sulphur lost their repellent properties by the end of the period. The loss of the distastefulness of the mixtures that contained lime-sulphur is to be noted as they were the most repellent at the initiation of the test. Lead arsenate and glucose, which was the least repellent of all the combinations used, soon lost its insecticidal properties when the foliage was subjected to the weather.

SAFENESS OF ZINC ARSENITE FOR USE ON FOLIAGE.

The purpose of these tests was to determine the safeness of zinc arsenite for use on foliage and its usefulness when combined with other sprays. Apple, pear, plum and peach trees in the Station nursery and individual trees of the dwarf orchard were used. Zinc arsenite was applied to five acres of grapes in the region of Fredonia by Mr. F. Z. Hartzell of the Chautauqua Grape Laboratory of the Station. Applications to elm and willow were made in a local nursery and several sprayings were made in a large basket-willow plantation at Lyons, N. Y.

EFFECT ON APPLE FOLIAGE.

EFFECTS ON APPLE FOLIAGE OF LEAD ARSENATE AND ZINC ARSENITE ALONE AND IN COMBINATION WITH OTHER MATERIALS.

Lead arsenate, paste	Water	No injury.
Lead arsenate, paste	Lime-sulphur	No injury.
Lead arsenate, paste	Bordeaux	No injury.
Lead arsenate, paste	Soap	No injury.
Lead arsenate, paste	Glucose	Slight marginal burning.
Zinc arsenite, dry	Water	Slight marginal injury.
Zinc arsenite, dry	Lime-sulphur	Very slight spotting of foliage.
Zinc arsenite, dry	Bordeaux	No injury to healthy foliage.
Zinc arsenite, dry	Soap	Injury slight, confined to margins and points of injury.
Zinc arsenite, dry	Glucose	Injury moderate to severe.
Zinc arsenite, dry	Lime	No injury.
Lead arsenate, dry	Water	No injury.
Lead arsenate, dry	Lime-sulphur	No injury except to broken leaves.
Lead arsenate, dry	Bordeaux	No injury.

It is to be noted that no injury to apple foliage resulted from the use of arsenate of lead alone or in combination with bordeaux or lime-sulphur, or from zinc arsenite with lime or bordeaux. Zinc arsenite alone or in combination with soap, glucose or lime-sulphur caused more or less injury. Zinc arsenite caused spotting of the leaves and injury about the margins. The spotting did not appear

until several days after treatment but was evident in twelve days, at which time the worst injured leaves had turned yellow. With zinc arsenite and lime-sulphur the same type of burning was present but to a less degree while in combination with glucose the injury was severe.

EFFECT ON GRAPE FOLIAGE.*

Test No 1.— On June 22 ten vines were sprayed with zinc arsenite at the rate of six pounds of the poison to one hundred gallons of water. By July 26 there was severe burning of foliage and fruit.

Test No. 2.— On June 24 ten vines were sprayed with six pounds of arsenite of zinc and two gallons of molasses in one hundred gallons of water. Foliage and fruit showed severe burning by July 26.

Test No. 3.— On July 12 one acre of grapes was sprayed, using zinc arsenite two pounds, molasses two gallons and water one hundred gallons. In two weeks injury was shown similar to that in the preceding tests.

Test No. 4.— On July 13 one acre of grapes was sprayed using two pounds of zinc arsenite to one hundred gallons of bordeaux mixture (formula 3–8–100). No injury resulted.

Test No. 5.— One acre of grapes was sprayed July 15 using two pounds of zinc arsenite to one hundred gallons of water. Injury was apparent within a week.

Test No. 6.— On August 16 a vine was sprayed with zinc arsenite two pounds, lime one-half pound and water one hundred gallons. No injury resulted.

The weather during the period of June 22 to July 12, the dates of the preliminary tests and the field experiment, was dry and hot, but after July 15 there was considerable rain and cool weather; so that the results noted above indicate that wet weather favors injury to the foliage by this poison. From June 22 to July 14 the average mean temperature was 73.1°, with a maximum of 91° but no rain. From July 15 to 25 the average mean temperature was 66 with a maximum of 83°. Rain fell on the 15th, 18th, 21st, 24th and 25th; 1.33 inches falling during this time.

Results.— Zinc arsenite when used alone or in combination with molasses caused severe burning of fruit and foliage of the grape. In these tests the injury was not apparent for a period varying from one to three weeks. Zinc arsenite when used in combination with lime or bordeaux mixture caused no injury to the foliage.

OTHER TESTS OF ZINC ARSENITE ON FOLIAGE.

In a few other preliminary experiments the results are as follows: A slight marginal injury occurred to the foliage of pear and plum. Peach leaves were severely scorched. Zinc arsenite caused no

* These tests were made and reported by F. Z. Hartzell, Associate Entomologist.

injury to the foliage of elms or to potatoes and cabbage. Willow leaves were only slightly spotted.

CONDITIONS THAT ACCOMPANY THE INJURY TO APPLE AND GRAPE FOLIAGE.

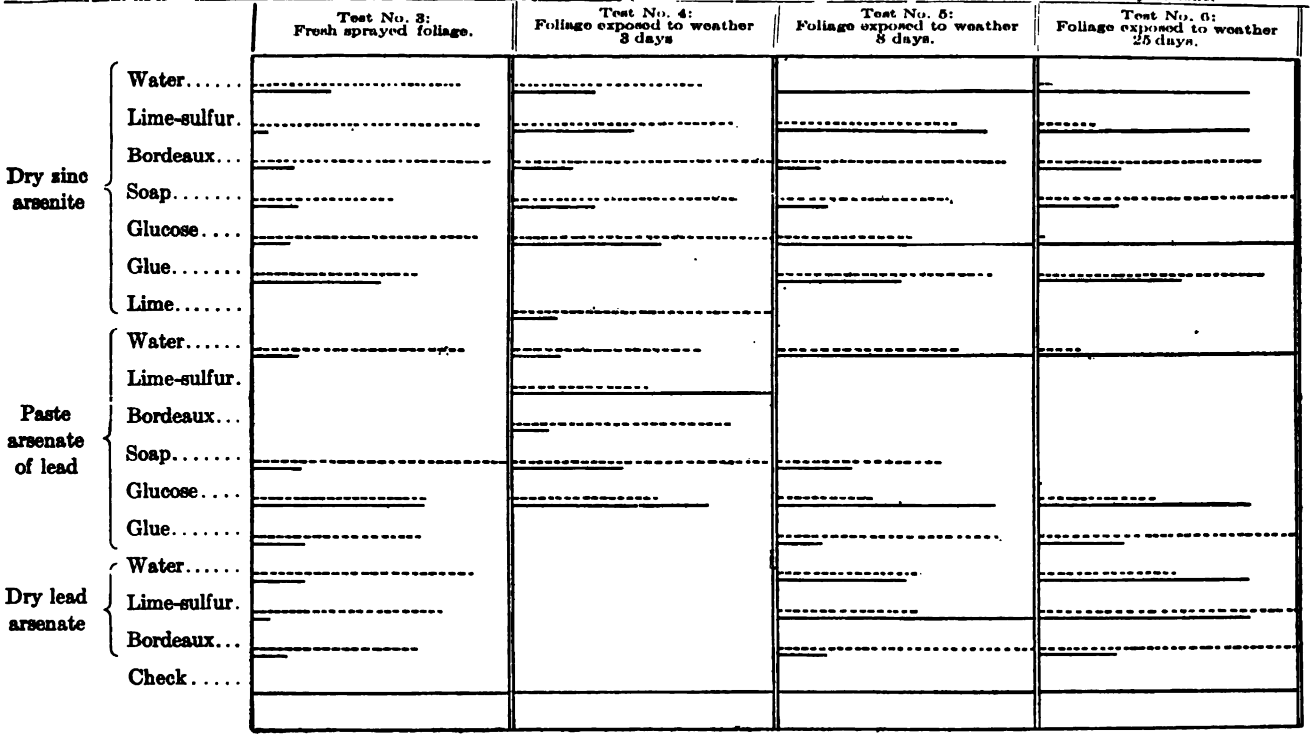
Attention is called to several of the above mentioned observations regarding the injury to foliage. The burning was prevented by lime and was increased by the addition of molasses. It did not occur immediately following the application of the poison, but only after several days; and then apparently it was favored by wet weather. As noted by Hartzell in the experiments on grape foliage, zinc arsenite when combined with lime or bordeaux mixture caused no injury. The same is true in the tests on apple foliage. The lime would function as an absorbent of carbon dioxide and would also unite with any soluble arsenic present, forming calcium arsenite.

The occurrence of the injury during wet weather points to leaching of the arsenic as a contributory cause. But the low water solubility of zinc arsenite, namely, one per ct. at a dilution of one to one thousand by weight, together with the fact that several days are required before the injury occurs, would indicate the necessity of some solvent other than water or that the compound is altered chemically before the burning takes place. The only suggestion in these tests as to the cause for the injury to the apple and grape foliage by zinc arsenite is the ease with which the material enters into solution in dilute carbonic acid. It is generally assumed that due to the process of respiration, carbonic acid is present at times in small amounts on the leaf surface. It is possible that the combined action of the wet weather and the solvent properties of the carbonic acid are partly responsible for the damage.

CHART I.—EFFICIENCY OF POISONS EXPOSED TO WEATHER.

——— Relative feeding of caterpillars as compared with check.

...... Effectiveness as determined by the percentage of caterpillars killed and condition of those alive at the termination of the experiment.



NOTE.—In experiments 3, 4 and 5 the length of the black line is based on the number of sq. cm. of estimated feeding that occurred during the first part of the experiment. In test 6 the feeding was generally such that it was not feasible to estimate the area and instead the expressions extensive, moderate, etc., were used. Upon these the line is based. Dotted line omitted in first section under Test 5 because caterpillars escaped after eating foliage.

THE INFLUENCE OF TEMPERATURE AND MOISTURE IN FUMIGATION.*

W. J. SCHOENE.

SUMMARY.

This bulletin discusses a series of fumigation tests with caterpillars of the brown-tail moth (Euproctis chrysorrhœa Linn.), which were influenced by temperature and humidity.

A greater number of caterpillars survived the fumigations made at low temperatures than at higher temperatures; also fumigations made under humid conditions were uniformly more destructive to the larvæ than tests that were conducted in a relatively dry air.

It is suggested that the differences in the results referred to above and the unusual resistance of the caterpillars to fumigation are due largely to the conditions incidental to hibernation, viz., the reduced moisture content and comparative inactivity of the insects.

INTRODUCTION.

Nests of the brown-tail moth were discovered about January 4, 1909, upon imported seedlings in several of the local nurseries, and during succeeding weeks thousands of them were secured upon similar stock in this and other nursery centers of the State. Seedlings carrying nests were destroyed as soon as detected, but as the examination of the shipments progressed it was observed that many of the nests were broken, thus permitting the hibernating caterpillars to be scattered promiscuously among the trees. The question then arose as to the most effective means of disinfecting the shipments in addition to destruction of trees bearing winter nests. As the nurserymen were equipped with fumigation plants and were familiar with the use of hydrocyanic acid gas, fumigation was suggested. Preliminary tests by this process failed to kill the hibernating caterpillars at ordinary strengths and at the request of Dr. Raymond A. Pearson, then Commissioner of Agriculture, this Station undertook to determine the conditions which rendered fumigation ineffective. In this work it soon became apparent that temperature and humidity were important factors, and it is desired in this bulletin to call attention to the role played by these two factors under the peculiar conditions in which fumigation was attempted.

* **Reprint of Technical Bulletin No. 30, July, 1913.**

SOME REFERENCES TO MOISTURE AND TEMPERATURE IN FUMIGATION.

Lowe and Parrott[1] found in their fumigation experiments for the San José scale that the strength of gas uniformly effective during the spring, namely, .18 gram potassium cyanide per cubic foot, was wholly ineffective when the tests were made during the winter. Johnson[2] calls attention to some of the effects of temperature and moisture in fumigation. He especially mentions the increased injury to the plant when fumigations are made at high temperatures. He also states that, in the fumigation of nursery stock, the plants should be dry previous to treatment.[3] In speaking of the preparation of the greenhouse he says: " The room should not be fumigated immediately after the plants have been sprinkled or watered."[4] Townsend[5] has shown that the presence of moisture is very important in the fumigation of seeds. In his tests moist seeds absorbed the cyanide gas which injured the germinating qualities and rendered it unfit for food; while the dry seed was unaffected. Hinds and Turner[6] in a series of experiments with the rice weevil (*Calandra oryza* L.) found that carbon di-sulphide at the rate of 5 lbs. per 1000 cubic feet was effective when the work was done at a temperature above 70° F., while fumigation work done at temperatures ranging below 60° appeared to be largely ineffective. The moisture factor was taken into account in these experiments, but Hinds says " we have not found as yet that moisture has anywhere near the same importance as temperature ".

In connection with the fumigation of citrus fruits in California, it has been generally assumed that if the work is carried on while the trees are damp injury to the foliage may follow. Penny[7] found in his studies that moisture on the leaves absorbed gas during the fumigation, though Gossard[8], Morrill[9] and Woglum[10] assert that the presence of moisture on the foliage is not important as affecting the results.

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[1] N. Y. Agr. Exp. Sta. Bul. 202, p. 206. 1901.
[2] Fumigation Methods, New York. 1902.
[3] L. c., p. 120.
[4] L. c., p. 128.
[5] Md. Agr. Exp. Sta. Bul. 75. 1901. L. c., p. 177.
[6] *Jour. Econ. Ent.* 3:47. 1910.
[7] Del. Agr. Exp. Sta. 12th Rept., p. 212–237. 1900.
[8] Fla. Agr. Exp. Sta. Bul. 67, p. 648. 1903.
[9] U. S. Dept. Agr. Ent. Bul. 76:12–14. 1908.
[10] U. S. Dept. Agr. Ent. Bul. 90:68–69. 1911.

METHODS.

At the time the work was planned, no data were available regarding previous efforts to kill hibernating larvæ of the brown-tail moth by fumigation. There were, however, conflicting rumors regarding the success or failure of certain preliminary experiments conducted in this and other states. The writer inferred that most of the preliminary tests would be conducted in the laboratory while in many nursery establishments the fumigatorium is out-of-doors. To avoid confusion regarding the particular conditions under which the work was done a number of fumigators were arranged so that the work could be carried on at different temperatures. The experiments herein described include only those made with larvæ that had been separated from the nest. The method followed was to dissect the caterpillars out of the nest, and place them on a cheesecloth-covered wire frame. The container was placed near the center of the fumigatorium during the period of treatment. An arrangement to effect the combination of the chemicals after the closure of the fumigator was used in practically all tests. Following fumigation the condition of the larvæ was noted and the receptacle carrying the caterpillars placed under a bell jar, so that they might be kept under observation, other examinations being made during the next two or three days. If at any time subsequent to fumigation an individual showed signs of life it was counted as alive. The fumigators, which were designated by letters, are briefly described as follows:

A — Cubic contents 3.53 feet. A wooden box, made of tongued and grooved boards. Heavily coated on interior with hard paraffin.

B — Cubic contents 21.2 cubic feet. A wooden box lined with two thicknesses of glazed paper.

C — Cubic contents 31.5 cubic feet. Made of tongued and grooved material and lined with two thicknesses of building paper.

D — Cubic contents 17.6 cubic feet. Made of wood and coated on the interior with paint and shellac.

Bell jar.— Cubic contents 648.62 cubic inches. Made dark by means of a metal cylinder.

FUMIGATION EXPERIMENTS.

In addition to preliminary work using glass fruit jars, and some final checking up in which one of the large nursery fumigatoriums was employed, more than a hundred separate experiments with insects were made. Besides these, numerous experiments were carried out to determine the effects of similar charges of gas on the various kinds of seedlings. The experiments with caterpillars have been classified according to the amount of cyanide used per cubic foot in each fumigation. For the purpose of discussing the effects

of humidity and temperature, only the fumigations at .3 gram per cubic foot will be considered. The work as a whole is briefly summarized as follows:

Tests at .15 gram per cubic foot.—Thirty tests ranging in time from one to sixteen hours. Of the fumigations ranging from one to four hours none were effective, while some of the experiments of four to ten hours' duration were effective in that all of the caterpillars were killed. The tests of sixteen hours' duration were all effective.

Tests at .2 gram per cubic foot.—Five fumigations ranging in duration from three to fifteen hours gave results similar to those above.

Tests at .3 gram per cubic foot.—To be discussed fully later.

Tests at .6 gram per cubic foot.—Twenty-five fumigations ranging in duration from one to five hours. Of the fumigations lasting one hour none were effective, those of one and one-fourth partially, and those lasting four and five hours entirely effective.

Tests at .75 grams per cubic foot.—Three fumigations of one hour duration at temperatures of 33 to 70 degrees, all larvæ killed.

Tests at .9 gram per cubic foot.—Three fumigations of one hour duration ranging from 24 to 70 degrees F., the test at 24 degrees F. wholly ineffective.

TESTS WITH .3 GRAM OF CYANIDE PER CUBIC FOOT.

Description.— These consist of thirty-eight separate fumigations, that ranged in duration from one to sixteen hours. The number of individuals included in each test depended upon the number available at the time the test was made, at least ten larvæ being used in each experiment. The temperature was noted at the beginning and end of each fumigation and the average of these readings was taken as the temperature of the test. The condition of humidity was secured by the use of a sling psychrometer. The readings were taken frequently until the range of humidity surrounding each fumigator was learned, and from time to time during the course of the work.

Discussion.— By a study of the data in Table I, opposite, it will be noticed that the fumigations made at low temperatures are least effective as judged by the numbers surviving treatment. This difference is apparent by comparing individual fumigations or by a mass comparison of the data. It will be seen that, of twenty-seven fumigations ranging in time from one to four hours and at temperatures above 59 degrees F., ten were successful in that all the insects were killed. Opposed to this, six fumigations ranging in time from one to five hours at temperatures of 48 degrees or less were all unsuccessful. By combining the results of comparable experiments, we

TABLE I.— FUMIGATION OF LARVÆ AT .3 GRAM PER CUBIC FOOT.
Tests made during January, February and March, 1909, at Geneva, N. Y.

Number of test.	Fumigator used.	Location of fumigator.	Condition of Temperature and Humidity: Dry bulb.	Condition of Temperature and Humidity: Depression of wet bulb.	Condition of Temperature and Humidity: Relative humidity.	Duration of test.	Total larvæ	Number of larvæ surviving.
			Degs.	*Degs.*	*Per ct.*	*Hrs.*		
1....	C........	Barn.......	46	2	86	1	12	8
2....	A........	Museum....	69½	13½	41½	1	10	7
3....	B........	Greenhouse.	72½	3	86	1	10	1
4....	A........	Attic.......	48	.....	.....	1¼	23	21
5....	A........	Museum....	52	(10)*	.....	1¼	14	1
6....	A........	Museum....	59	(10)	.....	1¼	30	10
7....	A........	Museum....	60	(10)	.....	1¼	15	6
8....	A........	Museum....	65½	13½	39½	1¼	20	12
9....	B........	Greenhouse.	67½	5	75½	1¼	15	3
10....	B........	Greenhouse.	68	(6)	.....	1¼	16	0
11....	B........	Greenhouse.	70	(6)	.....	1¼	17	2
12....	B........	Greenhouse.	70	(6)	.....	1¼	13	0
13....	B........	Greenhouse.	71	3	86	1¼	20	0
14....	B........	Greenhouse.	75	(6)	.....	1¼	20	0
15....	B........	Greenhouse.	75	(6)	.....	1¼	30	0
16....	B........	Greenhouse.	80	.....	.....	1½	18	7
17....	C........	Barn.......	17	.....	.....	2	18	18
18....	A........	Museum....	64	17	22	2	16	15
19....	A........	Museum....	61	10	49	2	25	18
20....	B........	Greenhouse.	76	10	59	2	30	20
21....	A........	Museum....	60	10	48	3	10	6
22....	B........	Greenhouse.	70	.....	.....	3	10	3
23....	Bell jar...	Laboratory.	70	.....	.....	3	10	0
24....	A........	Laboratory.	70	.....	.....	3	14	2
25....	Bell jar...	Laboratory.	70	.....	.....	3	16	0
26....	A........	Museum....	67½	6½	69	3	20	2
27....	A........	Laboratory.	66	12	44	4	20	2
28....	A........	Laboratory.	70	.....	.....	4	10	0
29....	Bell jar...	Laboratory.	70	.....	.....	4	10	0
30....	B........	Greenhouse.	68	2	90	4	23	1
31....	Bell jar...	Laboratory.	70	.....	.....	4	20	0
32....	A........	Museum....	70	.....	.....	4	20	5
33....	C........	Barn.......	34	.....	.....	5	10	3
34....	A........	Attic.......	48	.....	.....	5	10	9
35....	Bell jar...	Attic.......	48	.....	.....	5	19	2
36....	A........	Museum....	72½	5½	75	6	20	0
37....	A........	Museum....	67	4	80	10	20	0
38....	B........	Greenhouse.	65	.....	.....	16	24	0

* Wet bulb reading not taken. The figures in parentheses are based on temperatures taken during other tests, (10) represents the minimum of the various wet bulb temperature in the museum and (6) the maximum of the wet bulb readings in the greenhouse. The conditions of humidity were determined by means of wet and dry bulb thermometers and a sling psychrometer.

secure the data in Table II, which are so chosen that the effects due to moisture are nil and the general percentages represent differences due mainly to temperature.

TABLE II.— COMPARISON OF FUMIGATIONS MADE AT TEMPERATURES HIGHER THAN 59° F. AND LOWER THAN 49° F.

Cyanide used at .3 gram per cubic foot. Data Selected from Table I.

SUMMARY OF SIX FUMIGATIONS MADE AT TEMPERATURES LESS THAN 49° F.				SUMMARY OF TWENTY-ONE FUMIGATIONS MADE AT TEMPERATURES ABOVE 59° F.			
Number of test.	Hours of fumigation.	Number of larvæ.	Number survived.	Number of test.	Hours of fumigation.	Number of larvæ	Number survived.
1........	1	12	8	2-3....	1	20	8
4........	1½	23	21	7-15...	1½	176	23
17.......	2	18	18	18-20...	2	71	53
33, 34, 35.	5	39	14	27-32...	4	103	8
Total..........		92	61	Total.........		307	92
Survived, 66 per ct.				Survived, 25 per ct.			

In Table II, it should be noted that in six fumigations ranging in time from one to five hours at temperatures less than 49° F., sixty-six per ct. of the caterpillars survived, while of twenty-one fumigations ranging in time from one to four hours at temperatures above 59° F., only twenty-five per ct. survived.

Even more striking are the effects of moisture, as will be seen by reference to Table III. These experiments, made under temperature conditions that were very similar, show that only three per ct. of the larvæ survived when the air was moist as opposed to fifty-six per ct. when the air was dry. In addition, five of the eight fumigations made under moist conditions were entirely successful in that all of the insects were killed, while none of the eight tests made in a dry atmosphere resulted in the death of all the caterpillars.

Of most interest in this connection is the combined influence of a humid atmosphere and a high temperature as compared with the opposite condition. The data at hand do not afford comparable experiments sufficient in number to make a comparison on this basis. But by an examination of the whole table the combined effect of temperature and moisture may be noticed. Of the twenty-five failures recorded in Table I, that is, experiments in which some of the larvæ survived the treatment, five were at a temperature lower than seventy, five were in a relative dry air, and six were made at both low

temperatures and in a dry atmosphere. Of the eleven successful fumigations recorded in Table I—i.e., all larvæ killed—seven were in a moist air at a temperature above 67° F. and the other four at a temperature of 70°.

TABLE III.—EFFECT OF MOISTURE ON THE PERCENTAGE OF CATERPILLARS KILLED.

Data taken from Table I.

Experiments Made in an Atmosphere Showing a Difference Between Wet and Dry Bulb of 10 to 17 Degrees.					Experiments Made in an Atmosphere Showing a Difference Between Wet and Dry Bulb of 3 to 6½ Degrees.				
Number of experiment.	Temperature of exposure.	Hours of fumigation.	Number of larvæ.	Number survived.	Number of experiment.	Temperature of exposure.	Hours of fumigation.	Number of larvæ.	Number survived.
	Degs. F.					Degs. F.			
2	69½	1	10	7	3	72½	1	10	1
5	52	1½	14	1	9	67½	1½	15	3
6	59	1½	30	10	10	68	1½	16	0
7	60	1½	15	6	11	70	1½	17	2
8	65½	1½	20	12	12	70	1½	13	0
18	64	2	16	15	13	71	1½	20	0
19	61	2	25	18	14	75	1½	20	0
20	70	2	30	20	15	75	1½	30	0
Av. temp. 63¾ Survived, 56 per ct.			160	89	Av. temp. 64¼ Survived, 3 per ct.			141	4

THE RESISTANCE OF THESE INSECTS TO FUMIGATION AND THE EFFECTS OF VARIATIONS OF TEMPERATURE AND MOISTURE ON THIS CONDITION.

The insects were in a state of hibernation, which is without doubt the cause of this peculiar resistance to the poison. By hibernation we understand that the insect is in a resting state and the water content of the body is reduced.[11] In the caterpillar the openings to the body are mouth, anus and spiracles. The spiracles are the exterior openings to the tracheæ, ramifying tubes in the body, that are filled with air and other gases. The air in the tracheæ is separated from the blood by the moist membrane of the tracheal wall. In respiration the air passes through the spiracles into the tracheæ from whence the gases diffuse through the moisture in the membrane into the fluids of the body cavity. The movement of the cyanide gas into the organs of respiration is similar to that of oxygen. In a dormant insect it enters the tracheæ largely by diffusion, while in an active specimen, the gas is drawn in by the movements of the seg-

[11] Tower, W. L. An Investigation of Evolution in Chrysomelid Beetles of the Genus *Leptinotarsa*. Carnegie Institution, Washington, D. C. No. 48, p. 245. 1906.

ments.[12] Hydrocyanic acid gas differs from oxygen in its strong affinity for water and greater solubility. Briefly, the amount of gas that an insect can take into its tissues in a given time depends upon the movement of gas through the spiracles and the condition of the tracheal wall with reference to moisture.

Temperature.— Changes in temperature very probably affect the hibernating animal in several ways, but of most importance in this connection is the rate of metabolism and the resulting reflex movements. With many species of animals and plants the effect of temperature changes has been observed.[13] It has been found that a rise in temperature is accompanied by an increase in the rate of respiration. It continues to increase as the temperature rises, until the injurious action of the high temperature becomes manifested by a decrease in the respiratory activity. This change in the rate of function of the protoplasm certainly has some bearing on the quickness of action of the gas but is probably not so important in affecting the action of the poison as are the reflex movements that result from the increase in temperature. The caterpillar has no breathing apparatus other than the bellows-like movement of the segments. As long as the caterpillar was quiet the gas could only enter by diffusion, but when the caterpillar begins to crawl there is a pumping action that greatly hastens the movement of the gas. The supply of caterpillars used in these experiments was kept at a temperature of thirty-five to forty-five degrees. While the insects were held at a low temperature they remained quiet, but when raised to seventy degrees or higher they were stimulated to crawl. It appeared in these experiments that much of the difference in the results of the work at different temperatures was due to the movements of the caterpillars.

Moisture.— Changes in the moisture content of plants and lower animals are correlated with changes in the rate of metabolism. This is very evident in seeds, and Kolkwitz[14] has shown that proportional amounts of carbon dioxide are excreted by seeds having different amounts of moisture. With certain low forms of animal life, such as rotifers, tardigrades and nematodes, continued loss of moisture produces a desiccation-rigor, during which metabolism proceeds at a very low rate.[15] As mentioned above, the phenomena of hibernation of insects, which is a condition of reduced activity, have been observed in some species to be accompanied by a relatively low moisture content. If an insect is placed in dry air it will lose moisture,[16] and we have determined that a fly pupa will absorb or lose moisture, depending upon its water content and the humidity of the surround-

[12] Sharp, David. Cambridge Nat. Hist. Vol. V, p. 130.
[13] Davenport, C. B. Experimental Morphology. Part I, p. 225. 1897.
[14] Jost. Plant Physiology, Ox. Ed. p. 341. 1907.
[15] Davenport, C. B. Experimental Morphology. Part I, p. 60. 1897.
[16] Bachmetjew, P. Experimental Entomologische Studien. Zweiter Band. pp. 53-61. 1907.

ing atmosphere. Thus the percentage of moisture may vary, which might alter the rate of metabolism, but this could not seriously affect the respiration of the caterpillars under discussion until they had been in the changed atmosphere long enough to absorb perceptible water, which would not occur in the interval of fumigation. The caterpillars used in these experiments were in a hibernating condition and hence probably low in body moisture. If the insect gained or lost moisture, a part of this interchange would take place through the walls of the tracheæ. This might be very important in altering the effect of the hydrocyanic acid gas, for the poison enters the system mainly by dissolving in the moisture of the tracheal wall. It is presumed that the tracheal wall of an insect with a low-water content would be in a dried condition as compared with that of a normal insect. Surround such an individual with dry air and the inner surface of the tracheal tubes would remain dry, a condition that would not favor a rapid solution of the gas. However, surround the same insect with a moist atmosphere and the dried wall would at once begin to absorb water at its outer surface, which would facilitate the formation of prussic acid. Thus a slight increase in the moisture of the air might add much to the speed and effectiveness of the gas.

Conclusion.— It appears from the above analysis that the unusual resistance of these caterpillars to fumigation is due to a condition of hibernation in which the moisture content of the body is low and the insects are comparatively inactive. It is possible that the spiracles are partially closed, which would also lessen the effect of the gas. A rise in temperature is correlated with greater effectiveness, but this increase in the deadly properties is more apparent between fifty and seventy degrees than at lower temperatures. A dry air is not favorable to fumigation with cyanide when the insects are in a hibernating state, which suggests that the low moisture content which usually accompanies this condition is one of the factors that help modify the effect of the gas.

THE PEAR PSYLLA.*

P. J. PARROTT AND H. E. HODGKISS.

The psylla is one of the principal enemies of pear orchards, and in many localities of the State it is the most troublesome if not the most destructive insect pest of this fruit. It has ruined many crops of pears and has so weakened large numbers of trees that they have easily succumbed to winter-killing.

NATURE OF INJURY.

Severe damages to pear trees occur during periods of the superabundance of the psylla. The injuries are due primarily to the loss

Fig. 26.—Leaf cluster showing nature of injury by nymphs of pear psylla.

of plant juices extracted by myriads of the tiny insects which feed on the stems of leaves and fruits. The work of the first brood of larvæ or nymphs during the latter part of May or early in June, at the axils of the tender leaves and young fruits or on the under sides

* Reprint of Circular No. 20, January 22, 1913.

of the leaves, is especially destructive since it occurs at the time when the trees should be making their best growth. Injuries at this season are usually attended with more serious consequences than those occurring later. If conditions are favorable for the continuous breeding of the pest the damage becomes more aggravated with each succeeding brood and as a result there is a severe check to the growth of the trees. The leaves become stunted and discolored, being covered with dead, brown areas as a result of the extraction of the plant juices or of sun-scalding from the collection of honeydew on the leaves. If the attack is of long duration the leaves drop in large numbers and in some seasons trees are completely defoliated. Aside from direct injuries to the stems, the fruit suffers from the loss of foliage, ceases to grow in size, and during a prolonged outbreak much of the crop may fall prematurely. The trees endeavor to put forth new growth which, under the circumstances, is usually feeble. The new leaves are generally few in number and pale in color, contrasting strongly with the smutty, discolored wood and dark, stained foliage which has not yet fallen. Such an attack may not only check production for several years, but if repeated may prove fatal. Trees that have suffered from the psylla enter the winter in a weakened state and are susceptible to further injuries by low temperatures. Hard winters are not infrequently attended with the death or a languishing condition of pear trees following a severe outbreak of the insect.

Another attendant of an infestation by this pest is the blackening of the leaves and wood, which appear as if they had been smoked. This discoloration is due to the presence of the "sooty fungus" (*Fumago salicina*) which finds in the honeydew a congenial medium for its growth. The plant itself is harmless as it grows superficially and does not penetrate into the vegetable tissues. However, the fungus and the honeydew together form a coating over the tree which can hardly fail to affect detrimentally the normal vital action of the leaves and bark. Certain ants and flies are very fond of the honeydew and are often attracted by it in large numbers to infested trees.

DESCRIPTION OF INSECT AND LIFE HISTORY.

The Psyllidæ, to which this pest belongs, are closely related to the plant lice and they have certain habits in common with them. Both are sap-sucking insects, they have a high birth rate, and many generations are produced during the year. Psyllas are sometimes called jumping plant-lice on account of habit of the adult of giving a quick jump when disturbed and flying to a place of safety.

The stages in the development of this insect are the egg, larva or nymph, and the adult or fly. The egg is a small body, measuring about one-seventieth of an inch long, and is of an orange-yellow color. It is pear-shaped with the small end drawn out into a thread

while the larger end is attached to the bark by a short stalk. (Fig. 27.) The eggs are deposited about the bases of buds, in old leaf scars and on the bark of twigs and smaller branches. In western New York the eggs may usually be seen during the first week in April or about one week after the flies emerge from their winter quarters. In some seasons the eggs are so abundant as to cause the bark to have a yellowish appearance in spots. The newly-hatched nymph is a small, pale, soft-bodied creature with a single pair of red eyes, and its shape and the character of its external structures are represented in Plate XVIII, fig. 1. The young psylla undergoes several changes or molts. (Plate XVIII, figs. 2,3,4.) With each transformation the insect increases in size, and in the fifth stage it appears as a flat oval creature of a brownish color, with whitish or greenish mottling and with conspicuous dark brown wing pads. (Plate XVIII, fig. 5.) These are known to most pear growers as "hard shells." The nymphs are sluggish creatures and cling closely to the surface of the leaves and fruit. The adult is an active four-winged insect measuring about one-tenth of an inch in length. It has been compared to a miniature seventeen-year locust. (Fig. 28.)

Fig. 27. Eggs, enlarged, of pear psylla.

The adults or flies live over the winter preferably hidden in crevices under the loose bark of the trunks and larger branches of the trees. They have also been observed under fallen leaves or other debris which may be on the ground. During the first warm days of spring, even as early as the latter part of March, these flies crawl out of their hiding places and copulate. A change to colder weather checks their activities, but with rising temperatures they gradually distribute themselves over the trees by creeping or by flying, when they lay their eggs. If the weather continues warm the eggs are quickly laid in large numbers, but if the weather is variable with cold freezing rains or drops in temperature oviposition may extend over

Fig. 28. Pear psylla; winter adult, enlarged.

a much longer period. During the first week in May or about the time the cluster buds break apart the eggs begin to hatch and the young nymphs at once commence to suck the juices from the succulent twigs and leaves. The largest number of nymphs will usually be present on the trees about the time blossoms drop. A favorite place for the nymphs at this time is in the axils of the leaves and at the bases of the fruit stems. Within two or three days after hatching the nymphs cover themselves with honeydew which may eventually become so abundant as to disfigure the foliage and fruit. The amount of injury done by the insect varies to a large degree with the number of the nymphs. When numerous they take so much nourishment from the trees that the new growth, as previously described, is seriously checked and the trees assume a stunted, unhealthy appearance.

Successive generations of nymphs occur during the summer, approximately one month apart. The period of incubation of the eggs of the summer broods is shorter than with those deposited by the winter hold-over flies and averages about ten days.

With the approach of cold weather in the fall all of the insects are in the adult stage and these seek the shelter of the bark of the trunks and large limbs for protection for the winter.

NATURAL ENEMIES.

The pear psylla has several insect enemies which exert a marked regulatory and repressive action upon its multiplication. Most common and efficient enemies are a lace-winged fly and various lady-bird beetles. The psylla is also subject to the attacks of a parasite which develops within the bodies of the host. It seems to be a widely distributed and a very common attendant of the pest and destroys many of the nymphs. Parasitized nymphs of the last instar are bloated in appearance, and during some seasons they may be found in considerable numbers concealed in the rough bark of the trunk and larger branches of the tree. Useful as are the parasites they only limit the extent of damage and do not prevent the psyllas from developing in destructive numbers. If perfect immunity is desired the work of these natural auxiliaries should be supplemented by active measures on the part of the grower.

VULNERABLE STAGES OF PSYLLA AND SPRAYING DIRECTIONS.

Of the several broods of the psylla the hibernating or winter flies and the first brood of eggs and newly-hatched nymphs are most susceptible to spraying. Recent experiments conducted on a large scale have demonstrated the practicability of destroying this pest in these stages so that, as the season advances, sufficient numbers do not develop to cause important injuries. Directions for spraying are as follows:

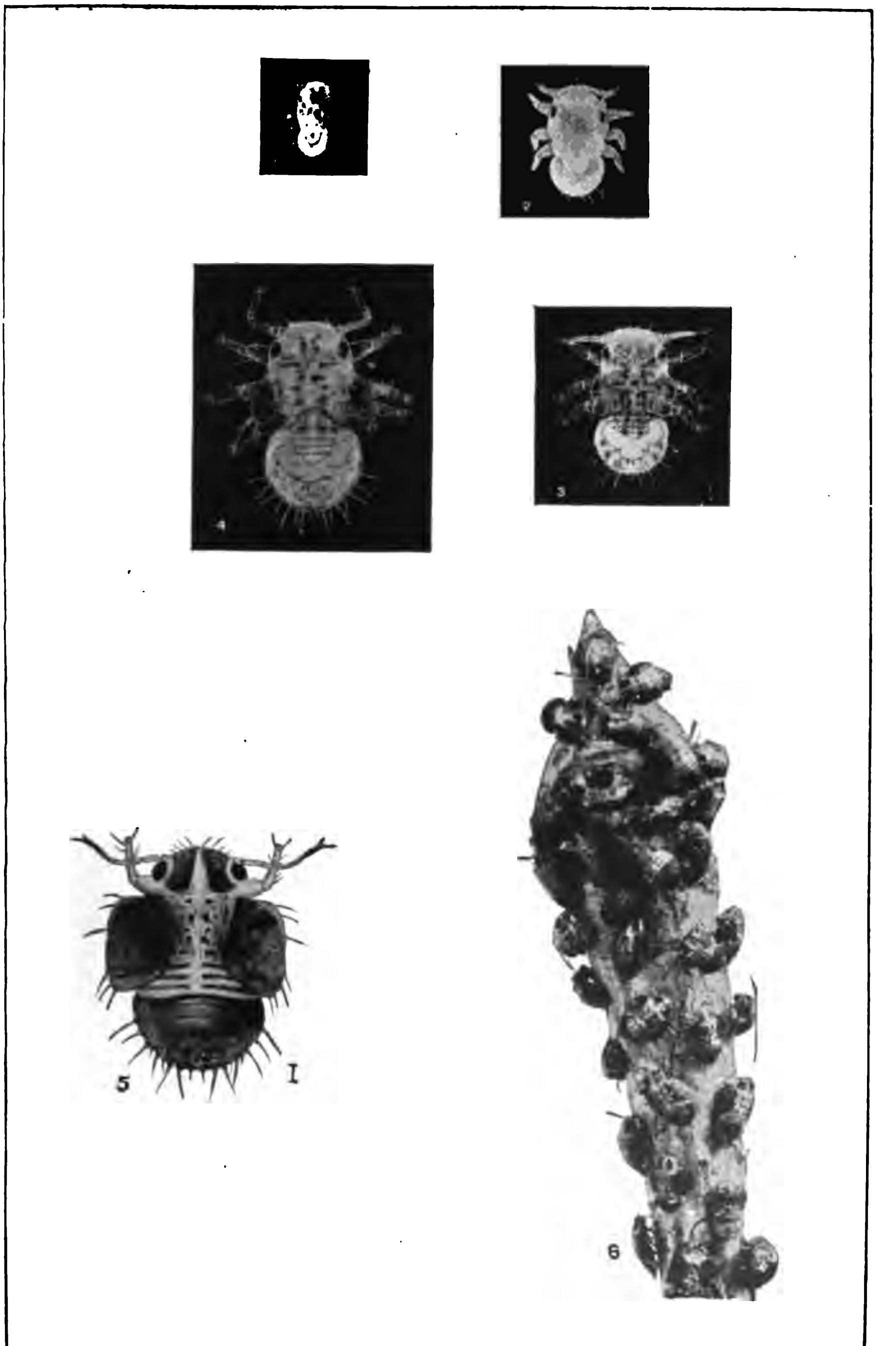

Plate XVIII.—Nymphs of Pear Psylla.

Figs. 1–5, five stages of nymphal development; 6, nymphs of fifth stage, "hard-shells," on twig

PLATE XIX.—SPRAYING FOR PSYLLA CONTROL.
Upper — Unsprayed Keiffer pears defoliated by psylla attacks.
Lower — Trees in same orchard sprayed for psylla nymphs.

1. *Spraying for hibernating or winter flies.*— Especial pains should be taken to destroy the pest in this stage, as effective work greatly reduces the number of eggs deposited on the trees and simplifies subsequent spraying operations. The best means of killing the "flies" is spraying during a period of warm weather, *preferably* in November or December, or during March or early April. A rise in temperature induces the insects to emerge from their hiding quarters and creep to the portions of the trees exposed to the warm rays of the sun and protected from a cold wind. While the insects are able to crawl they are very sluggish in their movements and do not fly. This habit makes them very vulnerable to treatment and the grower should take full advantage of it by so spraying that none of the insects be allowed to escape.

Fig. 29. Condition of blossom buds during the spraying for the "flies."

To kill the flies it is essential to wet thoroughly all portions of the trees, and especial pains should be taken to force the liquid under loose bark and into all cracks and crevices in the bark. The experiments by this Station have also shown the wisdom of spraying one tree thoroughly before proceeding to another. In balmy weather the flies, like squirrels, may dodge quickly to the opposite side of the tree. By spraying the entire tree they are unable to avoid wetting by the spraying mixture. Treatment late in the fall or early winter is especially recommended as the influence

Fig. 30. Conditions of trunk and larger limbs which attract winter "flies."

of steadily decreasing temperatures at this season on the movements of the flies makes them especially vulnerable to spraying. In planning for this work select days when there is no danger of the spraying mixture freezing on the trees. The most satisfactory spray from the standpoints of safety to fruit and leaf buds and effectiveness against the insect is three-fourths of a pint of Black Leaf 40 to one hundred gallons of water to which are added from three to five pounds of dissolved soap. (Formula 1.) It is also advisable to remove the loose and rough bark to discourage the flies from wintering on the trees and to render them more exposed to spraying mixtures. This operation may be done at a convenient time but the bark is more easily detached following a wet period. To avoid infection with disease care should be taken not to cut into live tissues.

Fig. 31. Condition of cluster buds for effective spraying for psylla eggs.

2. *Spraying for eggs of winter flies.*— The eggs about to hatch and the newly-emerged nymphs succumb to an application of the lime-sulphur mixture. In this lies a hint to the fruit-grower for an effective use of this spray against the psylla as well as the scale. The eggs of the psylla are laid principally during April and commence to hatch early in May or when the blossom cluster-buds are beginning to separate at the tips. (Fig. 31.) Most growers spray much earlier than this for the San José scale, but by postponing the treatment of pear orchards until the blossom clusters are well advanced one may deal another effective blow against the psylla and with the same treatment successfully combat the scale. The lime-sulphur solution, testing 32°–34° B., should be diluted in the proportion of one gallon to eight or nine gallons of water. (Formula 2.) The spray should be used in liberal quantities and pains should be exercised to wet all portions of the tree, especially the fruit spurs and the under sides of the young wood, where most of the eggs are laid.

Fig. 32. Conditions of blossom clusters during the spraying for psylla nymphs.

3. *Spraying for the first-brood nymphs.*— A third opportunity to strike hard at the psylla is when all of the eggs have hatched and the young nymphs are largely assembled in the axils of the young leaves and fruits. This occurs normally during the latter part of the blossoming period and the young insects can be reached by

spraying just as the blossoms drop. The most satisfactory spray is Black Leaf 40, using three-fourths of a pint to one hundred gallons of water to which are added from three to five pounds of dissolved soap. (Formula 1.)

4. *Late summer spraying.*— The grower should endeavor to combat the pest by the preceding measures and thus avoid, if possible, the necessity of later spraying. If the trees are badly infested during the summer time it is a very difficult task to bring the pest under control as there is an intermingling of all stages of the insect, and some of them are resistant to any spraying mixtures which can safely be used on foliage. Moreover the leaves, especially if the growth is heavy, seriously interfere with thorough treatment, and there is also danger that foliage injured by the psylla may be further damaged by the applications of the sprays.

Frequent and thorough spraying with the nicotine extract (Formula 1), on the first discovery of injurious numbers of the insects is the most satisfactory means of affording protection to the trees.

NUMBER OF SPRAYINGS NECESSARY TO CONTROL THE PSYLLA.

With careful work it is not necessary to carry out all of these measures each year. If the trees have been carefully scraped a combination of treatments (1) and (2) or (1) and (3), as explained above should be sufficient. Some growers have entirely controlled the psylla with treatment (1) alone to kill the hibernating flies.

SPRAYING MIXTURES AND FORMULAS.

Formula 1. Nicotine Extract.

Nicotine extract 40 per ct. (Black Leaf 40)	¾ pt.
Water	100 gals.
Soap	3 to 5 lbs.

This is recommended for winter spraying to destroy the flies or for summer treatments to kill the young nymphs.

Formula 2. Lime-Sulphur Mixture.

Lime-sulphur solution (32°–34° B.)	1 gal.
Water	8 to 9 gals.

To be applied just as the blossom cluster-buds separate at the tips to destroy psylla eggs about to hatch and newly-emerged nymphs.

Formula 3. Kerosene Emulsion.

Kerosene	2 gals.
Whale-oil or fish-oil soap	½ lb.
Soft water	1 gal.

Directions for making kerosene emulsion are as follows:

Dissolve the soap, which has been finely divided, in one gallon of boiling water. Remove the vessel from the stove and add the oil.

Then agitate the mixture violently for from three to five minutes by pumping into itself under high pressure until a creamy mass is formed, from which the oil does not separate. Fruit-growers are advised not to employ an emulsion which shows a separation of the oil as application of such preparations may cause injuries to the trees. This is used with success by some growers for summer spraying against the nymphs at a dilution of one gallon of the emulsion to eight gallons of water.

FORMULA 4. MISCIBLE OILS,

These are proprietary oil emulsions and have been used with very satisfactory results for spraying during March to destroy the hibernating flies. One gallon of the miscible oil is usually employed with fifteen gallons of water. They are rather dangerous sprays and should be used only in the spring as buds are swelling and never after buds once begin to show green at the tips.

FAILURES TO CONTROL PSYLLA.

Most growers meet with little success in their efforts to protect pear orchards from the psylla. The causes for failures are not always apparent. The most conspicuous weakness in present methods of combating the insect is the lack of a definite system of treatment because of the belief that the pest is periodical in its attacks — a fallacy as shown by the experiences in many of the best and well-known pear orchards in this State. The average grower is not accustomed to spray annually and consequently there is a period of one or more years when breeding of the pest is uninterrupted, which permits the psylla to develop to destructive numbers. Moreover orchardists are not familiar with the life history and habits of the insect, and spraying operations conducted without any knowledge of an insect's activities are not as a rule calculated to give uniformly efficient results. It is a common experience that the presence of the psylla in numbers capable of causing much harm is usually not apprehended until the appearance of honeydew in more or less conspicuous quantities. These conditions are most unfavorable for effective spraying.

THE FALSE TARNISHED PLANT-BUG ON PEARS.*

P. J. PARROTT AND H. E. HODGKISS.

This is, in certain sections of western New York, a troublesome insect to pear growers. While its injurious work has attracted attention for a long time very little has really been known regarding the miscreant itself and only recently have its identity and activities as an orchard pest been understood. Aside from the results of these studies, experiments conducted by this Station have also demonstrated that the plant-bug is amenable to spraying.

FIG. 33.—FALSE TARNISHED PLANT-BUG: ADULT.

DESCRIPTION OF INSECT.

The adult or parent insect is a plant-bug of the shape indicated in Fig. 33. It is about one-fourth of an inch in length and is darkish brown or yellowish brown in color. The mature insect is very similar in its appearance to the common tarnished plant-bug *Lygus pratensis* L. which occurs on a great many wild and cultivated plants and is well known to many farmers. The close resemblance between the two forms has suggested the name "false tarnished plant-bug" for the species *Lygus invitus* Say, which attacks pears.

FIG. 34.—THE EGG.

The egg is a tiny, pale body which is of a cylindrical form as represented in Fig. 34. The nymphs (Fig. 35) which hatch from the eggs are small creatures which at first are pale in color but become green as they approach maturity. In all stages they have the same general form and differ

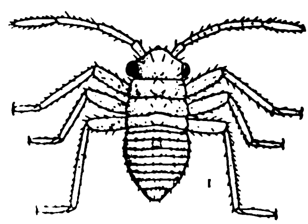

FIG. 35.—FIRST STAGE NYMPH.

* Reprint of Circular No. 21, February 10, 1913.

only in successive periods of growth by an increase in size and by the appearance of wing pads (Fig. 36).

NATURE OF INJURY.

The newly-hatched nymph (Fig. 35) attacks first the tender leaves of the pear, which become blackish about the points of injury. If feeding is extensive the margins of the leaf become discolored and shrivel. The dead areas later become detached from the healthy tissues and cause the leaf to have an irregular outline. The older nymphs (Fig. 4) attack the young fruit, which is the principal injury by this pest. The nymph thrusts its bill or proboscis deeply into the substance of the tiny pear, and when this is withdrawn drops of sap flow from the puncture (Fig. 37). With the drying of the sap the injury appears as a small blackish spot or point. A single nymph may stab a small pear many times, and while the initial wounds are at first slight and seemingly inconsequential they however produce a disfiguration which becomes increasingly prominent as the fruit increases in size (Fig. 38). Mature pears have the epidermis ruptured in spots while the protruding exposed surfaces are mealy-like and light yellow in color, contrasting strongly with the normal exterior of the fruit. The pustular areas are hard and flinty and a knife cuts with difficulty through them. Pears that have been much punctured by this species are usually undersized and much deformed and present somewhat the appearance of a badly scabbed pear. (Plate XX.) All the leading sorts of pears are subject to injury. The extent of losses from the work of this insect varies in different orchards and according to the season. Some plantings are subject to more or less injury every year. In 1908 this insect

FIG. 36.—FIFTH STAGE NYMPH.

FIG. 37.—YOUNG PEAR WITH SAP EXUDING FROM PUNCTURES.

Plate XX.—False Tarnished Plant-Bug Work on Pears.

damaged 75 per ct. of the pears in the well-known orchard of Mr. Wright McCollum of Lockport and it was estimated that the loss of fruit as a result of the attack was approximately one-half of the crop.

LIFE HISTORY AND HABITS.

Hatching occurs during the period when the trees are coming into blossom and until pollination is completed and the young fruits are the size of filberts. During recent years the young nymphs have appeared in greatest numbers at about the time when petals

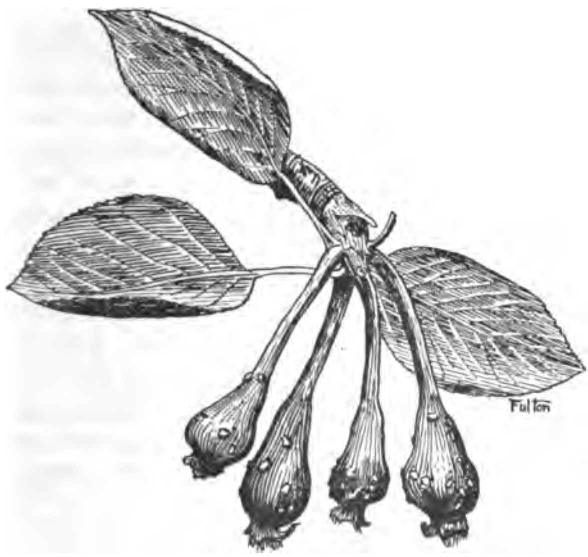

FIG. 38.—PEAR CLUSTER SHOWING EARLY INJURIES.

began to drop. The newly-hatched forms (Fig. 3) are frail but very agile creatures and seek the tender unfolding leaves which they may puncture severely. With the second molt the nymph is green in color, while the integument is tough and horny. In this stage the insects are less active and remain quietly on foliage and fruits for considerable periods of time. These nymphs are the first to cause marked injuries to the fruit, which is in part explained by their increased size and relatively sedentary habits. The principal damage to pears is done in the month of May. During the first two weeks in June the insects are mostly in the fifth or last nymphal

stage, and the mature or winged forms normally appear about the second or third weeks of this month. The adults remain on the trees among the succulent growth and on the fruit for a short time after their emergence and then disappear from the orchards.

CONTROL OF INSECT IN PEAR ORCHARDS.

As injury occurs within a short period after fruit has set the orchardist should examine his trees carefully, commencing with the dropping of the petals, to note conditions with respect to the nymphs. If they appear to be numerous he should resort to spraying to protect the crop. Taking one season with another an application just after the blossoming period should afford adequate protection. Treatment should not be delayed until injuries commence to show on the young fruits. In the Station's spraying tests Black Leaf 40, using three-fourths of a pint of the extract to one hundred gallons of water to which are added three pounds of soap, has given the most satisfactory results of the various mixtures which have been tried. In applying the spray the trees should be drenched, special pains being taken to wet both surfaces of the leaves. Some growers have combined the nicotine extract with dilute lime-sulphur containing arsenate of lead as applied for codling moth with equally satisfactory results on both insects and foliage and by this means avoided the necessity for an extra spraying. But as there is danger of burning pear foliage by drenching the trees with lime-sulphur, we would advise as a general recommendation a special treatment with nicotine and soap to combat this pest.

THE CONTROL OF PLANT LICE ON APPLE TREES.*

H. E. HODGKISS AND B. B. FULTON.

Plant lice are among the most harmful pests of the apple. During recent years these insects have been very destructive in many orchards in the leading apple-growing sections of New York. The species of aphids which occur on this fruit are the green apple-aphis (*Aphis pomi* DeG.), the rosy apple-aphis (*Aphis sorbi* Kalt.), the European grain-aphis (*Siphocoryne avenæ* Fab.), and the woolly apple-aphis (*Schizoneura lanigera* Hausm.). The most injurious forms are the green apple-aphis and the rosy apple-aphis. The woolly apple-aphis is abundant only in occasional years.

Fig. 39.— Leaves curling from aphis attacks.

NATURE OF INJURY.

Injuries from plant lice result chiefly from the extraction of plant juices by the insects which feed upon the foliage (Plate XXI, fig. 1) and fruits. Young, tender, growing twigs and succulent sprouts afford the most congenial conditions for aphids and on those they multiply very rapidly. The lice choose by preference the lower and more dense portions of the trees and are less often found in the topmost branches. The work of the aphids during May and June is especially destructive since it occurs during the period when next year's fruit buds are forming and when the vigor of the trees is also required for the development of the young apples of the current season's crop. If favorable conditions exist for the rapid increase of the pests the leaves become curled (Fig. 39) and the development of the young

* Reprint of Circular No. 23, March 4, 1913.

fruit is checked. The usual "June drop" fails to occur and the apples do not increase in size but cling tightly to the twigs, forming the "cluster" apples so familiar to fruit-growers. (Plate XXII, Fig. 2.) Continuous breeding of large numbers of the insects aggravate the injuries and the leaves become tightly curled, discolored and thickly coated with honeydew. During prolonged outbreaks the injured leaves turn brown and drop, causing more or less extensive defoliation. Fruits that have escaped earlier attacks from the lice become stunted, or deformed, or the epidermis may become ruptured. (Plate XXI, fig. 2.) Fruit which reaches a good size may be rendered worthless from a coating of the honeydew.

The attacks of the woolly aphis result in spongy swellings on the roots and on the smaller twigs and branches. (Plate XXII, fig. 3.) On the branches these galls crack, forming favorable entrance places for injurious fungi and for other insects. (Plate XXII, fig. 4.) The roots of young trees may be killed if the galls are abundant. Trees weakened by aphis attacks enter the winter in a poor condition and are liable to injury by low temperatures.

DESCRIPTION OF INSECTS AND LIFE HISTORY.

The green apple-aphis.— The eggs of this species are laid during October and November on succulent twigs, in crevices in the bark or at the bases of the buds. These eggs (Fig. 40) are minute oval bodies about one seventy-fifth of an inch in length and of a greenish color when deposited but later they become shiny black, in which condition they remain until hatching occurs in the spring. As the buds begin to expand during the latter part of April the young lice hatch and make their way in large numbers to the green ends of the opening buds. The newly hatched aphids (Plate XXIII, fig. 2) are very small oval bodies about one-fiftieth of an inch in length. At birth the insects are of a very dark, green color but become lighter as they attain full size. These individuals are all females and when fully developed (Plate XXIII, fig. 6) give birth to living young aphids which become viviparous females. (Plate XXIII, fig. 5.) As opportunity is afforded the insects work into the interior of the buds and seek the protection given by the hairy growth of the unfolding leaves. The numbers of the lice increase rapidly and in a comparatively short period of time the buds, foliage and blossoms are thickly covered by the pests. The aphids are at first wingless, but about the first of June in Western New York, or two weeks later in the more northern apple districts, winged females (Plate XXIII, fig. 4) appear which migrate to other trees and extend the area of infestation. Winged and wingless females continue to appear on the trees throughout the

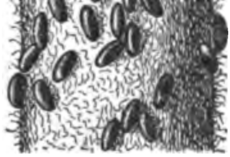

Fig. 40.— Eggs of green apple-aphis. (Much enlarged.)

summer, and in favorable years for the breeding of the insects several broods may occur. About the first of September sexual forms of the lice appear on the trees. The male aphids (Plate XXIII, fig. 1) are very small pear-shaped wingless creatures and are brownish or pinkish in color. The egg-laying females (Plate XXIII, fig. 3) are wingless and green in color. Both winged viviparous females and the sexual individuals may be found on apple foliage well into the winter.

The rosy apple-aphis.— With this species the eggs are deposited in the fall, mostly upon the trunks and larger branches of apple trees. About the time the leaves unfold in the spring the young, pale-colored nymphs (Plate XXIV, fig. 2) hatch from the eggs and gather on the young leaves and tender shoots of the trees. These lice at maturity are wingless (Plate XXIV, fig. 3) and may be recognized by a reddish coloration of their bodies. These females give birth to winged and wingless individuals which in turn give rise to similar forms. The development of the insects is very rapid; about three generations of the rosy aphis occur before the middle of June. Usually by the first week in July, in New York, the lice leave the trees and do not again appear until autumn when winged females (Plate XXIV, fig. 1) seek the trees for the purpose of producing sexed individuals (Plate XXIV, fig. 4).

The European grain-aphis.— This species is much smaller in size than the green apple-aphis and is lighter in color. The eggs are found on both apple and pear trees, where they hatch as the buds are expanding in the spring. Two or three generations of the females may develop on the trees, after which the lice migrate to grains or grasses, where they breed until the autumn. At that period winged females migrate to apple or pear trees where sexual individuals soon appear and deposit eggs which do not hatch until the spring. The lice usually disappear from bearing fruit trees before severe injuries occur, but in nursery plantings the foliage is often badly curled from the attacks of the aphis and blackened by the sooty fungus growing on the "honeydew."

The woolly apple-aphis.— These insects are easily recognized on account of having a white, woolly covering. (Plate XXII, fig. 1.) Their bodies are of a reddish color and the females are wingless until the third generation when winged individuals appear and migrate to other trees or parts of the same tree. These give rise to sexual forms and the females deposit a single, rather large brown egg.[1] Recent investigations [1] indicate that the woolly aphis has as an alternate host elm trees to which the winged females migrate in the fall for the purpose of depositing eggs. The lice also live on the roots of trees and these individuals supply a portion of the aerial infestation. The woolly aphis hibernates in the egg, and as living individuals in scars on the limbs and on the roots of trees beneath the surface of the ground.

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[1] Me. Expt. Sta. Bul. 203. 1912.

NATURAL ENEMIES.

Plant lice have a number of predaceous and parasitic enemies and fungus diseases which exert a marked restraining influence upon the increase of the pests. The twice-stabbed lady-beetle (Plate XXIV, figs. 5, 8), aphis lions (Plate XXIV, figs. 9, 10) and the larvae of syrphus flies (Plate XXIV, figs. 6, 7) are common and efficient enemies of the insects. Aphids are also subject to the attacks of a parasite which develops within the body of the host. Under favorable weather conditions fungus attacks appreciably reduce the numbers of the lice. During periods of inclement weather the work of the insect enemies of plant lice is noticeably retarded and the aphids increase rapidly, but with the advent of fair weather the insect enemies become abundant and the aphids are correspondingly lessened in numbers. Useful as are these predaceous and parasitic insects they only limit the extent of the damage and do not prevent the aphids from developing in destructive numbers. If perfect immunity is desired, the work of these natural agencies should be supplemented by active measures on the part of the grower.

Fig. 41.—Aphids on opening bud; period for spraying.

SPRAYING DIRECTIONS.

Experiments conducted by this Station during the last three years indicate that plant lice are most vulnerable to sprays, (1) when the aphids are appearing on the green tips of the buds, and (2) when the leaves have unfolded but have not been curled by the lice, which is usually just before or immediately after blossoming. In some of the tests thorough applications of sprays during these periods have afforded protection to the trees. To what extent these treatments will afford immunity from later attacks of the insects in years when lice are superabundant has not so far been determined.

This phase of the problem is still under investigation. But on the basis of the experimental work conducted in the past, the following suggestions are offered to fruit-growers as a guide for future spraying operations in an effort to protect their orchards from these insects.

Fig. 42.—Apple buds too far advanced for aphis spraying.

1. *Spraying for newly hatched lice.*— Especial pains should be taken to destroy the pest at this stage as thorough work greatly reduces the subsequent numbers of the lice and may simplify later spraying operations. The best means of killing the newly hatched lice is a treatment during a period when the tips of the buds show green and while the buds are still compact. (Fig. 41.) It is important to spray early, for if the treatment is delayed the aphids obtain protection in the fuzzy, unfolded

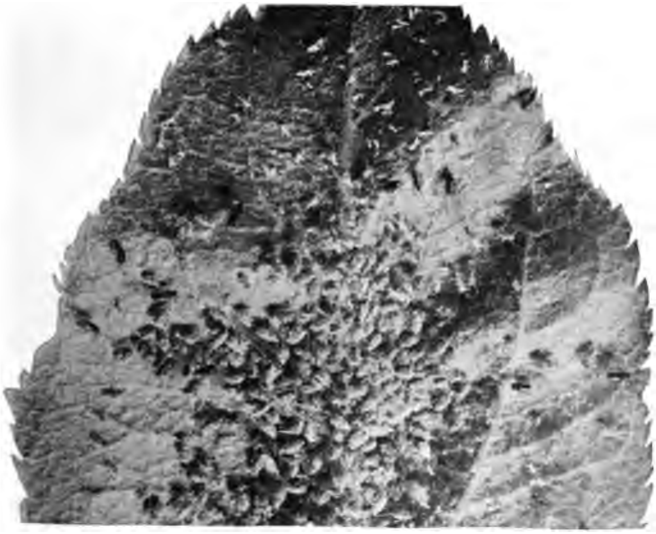

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Plate XXI.—Work of Aphids.
1, Colony on under surface of leaf; 2, apple deformed as result of aphis work.

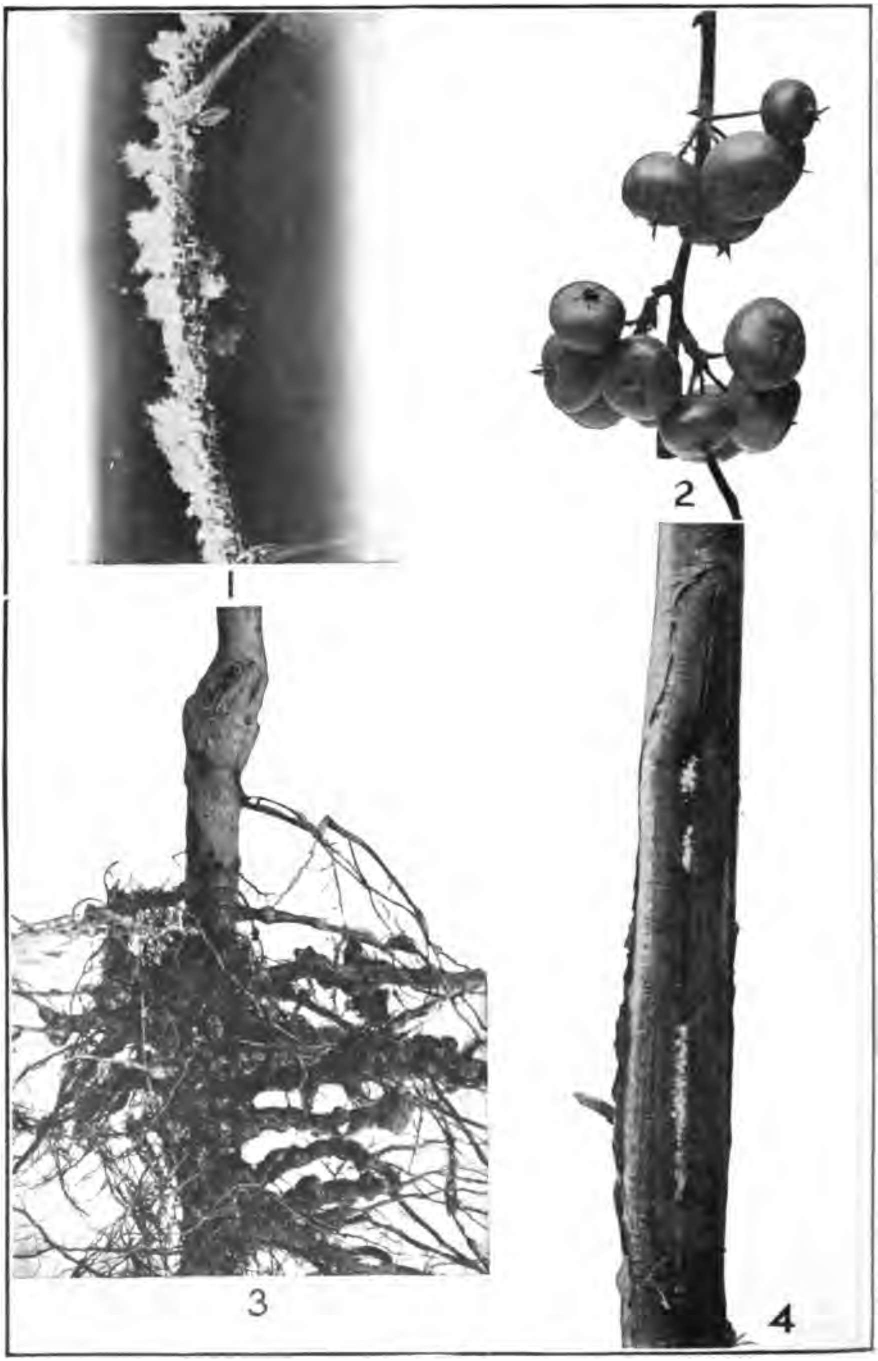


Plate XXII.—Work of Aphids.

1, Woolly aphis on twig; 2, "cluster" apples, caused by aphids; 3, woolly aphis galls on roots; 4, injury to apple stem by woolly aphis.

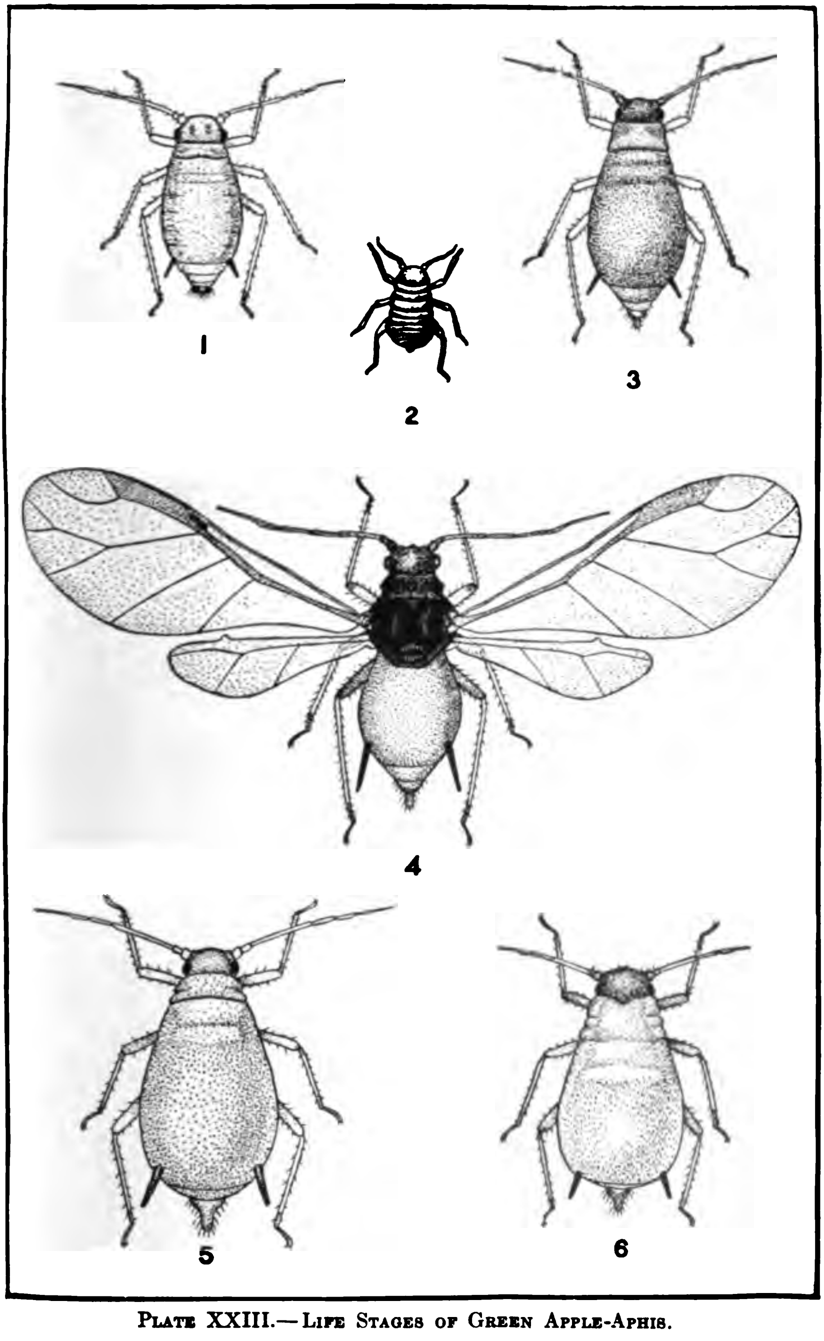


Plate XXIII.—Life Stages of Green Apple-Aphis.

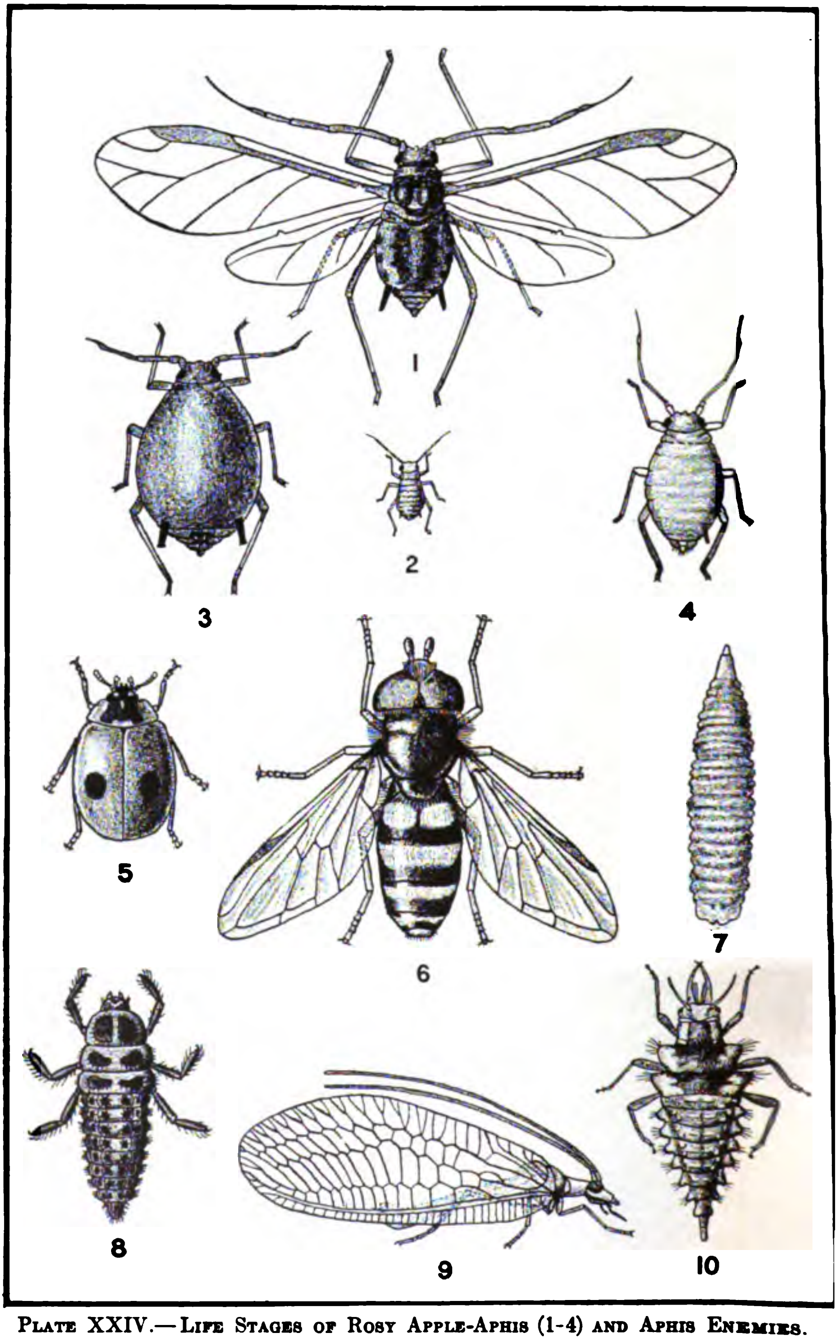


PLATE XXIV.—LIFE STAGES OF ROSY APPLE-APHIS (1-4) AND APHIS ENEMIES.

leaves of the opening buds where they are protected from applications of spray mixtures. (Fig. 42.) The most satisfactory preparation from the standpoint of safety to the buds and effectiveness against the insects is three-fourths of a pint of Black Leaf 40 to one hundred gallons of water to which are added from three to five pounds of dissolved soap (Formula 1). Many growers who are spraying at this time for the San Jose scale with the lime-sulphur solution place the nicotine in the dilute spray material. This is a desirable practice and if it is done the soap may be omitted from the combination. Kerosene emulsion (Formula 2) is also available for this treatment but may not be added to the lime-sulphur solution.

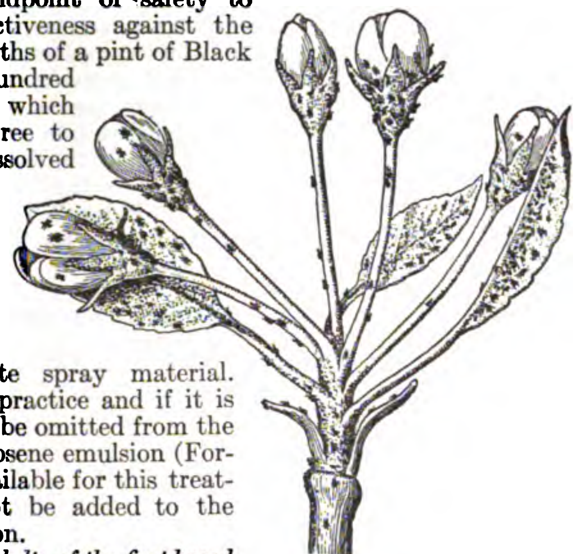


Fig. 43.— Aphis on cluster of unopened blossoms; a good time to spray.

2. *Spraying for adults of the first brood and second brood young.*— Individuals of these stages are very susceptible to contact sprays. They are usually active upon the trees during the period extending from the appearance of the color in the unopened blossoms (Fig. 43) to the dropping of the petals (Fig. 44). Very effective work may be done in spraying for the lice at one or both of these times with Black Leaf 40 using three-fourths of a pint to one hundred gallons of water to which are added from three to five pounds of dissolved soap (Formula 1) or kerosene emulsion (Formula 2). The Black Leaf 40 may be used in the dilute lime-sulphur spray for apple scab at either of the periods above mentioned. In such instances the soap should be omitted.

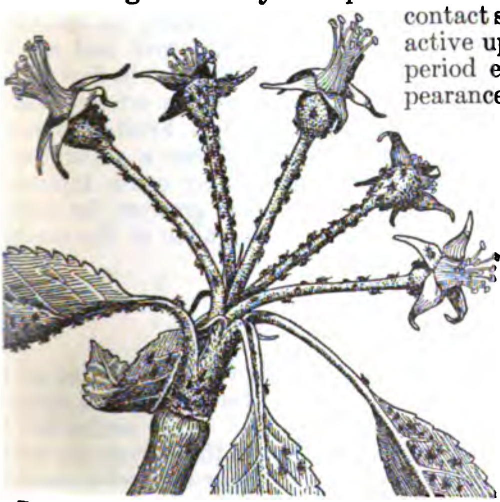


Fig. 44.— Petals fallen; stage for very effective spraying.

Late summer spraying.— The grower should endeavor to combat the pests by the preceding measures and thus avoid, if possible, the necessity of later applications. If earlier treatments have preserved the leaves and checked the development of the insects, later sprayings may be advisable to avoid injuries from the late summer broods. Frequent and thorough spraying with nicotine extract (Formula 1) is the most satisfactory means of affording protection to the trees and should insure against late attacks of the lice.

For the woolly aphis a spraying of the infested portions of the limbs is usually sufficient to reduce the insects to unimportant numbers. Either Black Leaf 40 (Formula 1) or kerosene emulsion (Formula 2) is a suitable summer spray for this purpose.

SPRAYING MIXTURES AND FORMULAS.

FORMULA 1, NICOTINE EXTRACT.

Nicotine extract 40 per ct. (Black Leaf 40)	¾ pt.
Water	100 gals.
Soap	3 to 5 lbs.

FORMULA 2, KEROSENE EMULSION.

Kerosene	2 gals.
Whale-oil or fish-oil soap	½ lb.
Soft water	1 gal.

Directions for making kerosene emulsion are as follows:

Dissolve the soap, which has been finely divided, in one gallon of boiling water. Remove the vessel from the stove and add the oil. Then agitate the mixture violently for from three to five minutes by pumping into itself under high pressure until a creamy mass is formed, from which the oil does not separate. Fruit-growers are advised not to employ an emulsion which shows a separation of the oil as application of such preparations may cause injuries to the trees. This is used with success by some growers for summer spraying against the lice at a dilution of one gallon of the emulsion to eight gallons of water.

FAILURES TO CONTROL PLANT LICE.

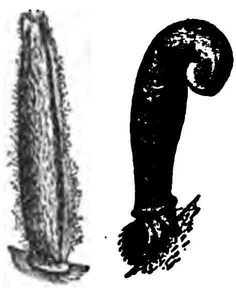
Efforts to protect bearing apple orchards from plant lice are, as a rule, failures. These are due mostly to the manner of spraying and the lateness of making the applications. Most orchardists do not spray until the insects are abundant and the leaves are curled. Little benefit is derived from treatments under such circumstances as not many of the lice are destroyed, and besides there is always great danger that the most of the injury by the insects is done. The foliage on which the lice have been feeding becomes weakened and may prove susceptible to further injuries from spraying mixtures.

Instead of waiting until injuries begin to show, the grower should spray before many of the leaves have curled and the lice have developed to formidable numbers.

APPLE INSECTS.*

W. J. SCHOENE AND B. B. FULTON.

The apple is subject to attack by a great many insects. This circular has been prepared with the view of affording practical aid to the apple-grower in his contest with them. The more important species only are considered, which should be recognizable by the accompanying illustrations. There is also included a brief outline of the principal sprayings for the apple. However, it should be understood that diseases and insects vary greatly in destructiveness from one year to another, according to seasonal conditions. This spraying schedule should therefore be used with discretion. If a disease or insect is very destructive the grower should familiarize himself with the special bulletins on the subject.



a b

FIG. 45.—CASES OF CIGAR CASEBEARER (a) AND PISTOL CASEBEARER (b).

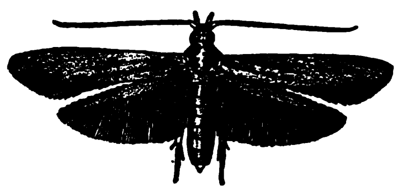


FIG. 46.—MOTH OF PISTOL CASEBEARER.

CASEBEARERS.

PISTOL CASEBEARER, *Coleophora malivorella* Riley.

CIGAR CASEBEARER, *C. fletcherella* Fern.

The pistol casebearer and the cigar casebearer (Fig. 45) are frequently troublesome in apple orchards. The life histories are very similar. The young caterpillars of the pistol casebearer live over winter in the little pistol-shaped cases of silk which are attached by one end to the twigs, usually near and sometimes on the buds. (Plate XXV, fig. 1.) These cases measure about one-eighth of an inch in length and resemble the bark in color. Early

FIG. 47.—ADULT BUD MOTH.

* Reprint of Circular No. 25, April 25, 1913.

in spring, a short time before the leaf buds burst, the hibernating casebearers become active. They attack the growing buds, gnawing the outer covering to feed on the tender tissues beneath. Later in the season they feed upon the interior tissues of the leaf in the same manner as a leaf miner. The larvæ reach maturity and cease feeding about the middle of June, and moths (Fig. 46) appear in July. These deposit eggs from which larvæ hatch. They feed upon the foliage in late summer and with the approach of winter attach their cases to the twigs.

Treatment.— These insects rarely become destructive in orchards that are systematically sprayed. The important treatment is the application of an arsenical poison before blossoms open. If an orchard is badly infested the grower should spray very thoroughly and use arsenate of lead in larger amounts than is commonly employed.

BUD MOTH.

Tmetocera ocellana Schiff.

The larva of this insect hibernates over winter under a tiny shelter on the young wood and in the spring it attacks the opening buds. Later, when the leaves and blossoms unfold, it seeks the clusters, forming a retreat in the webbed leaves. (Plate XXV, fig. 3.) By reason of its destructiveness to buds and blossoms the bud moth is during some seasons a serious pest. The caterpillar (Plate I, fig. 2) is darkish red in color and pupates in June. The moth (Fig. 47) makes its appearance about ten days later and soon afterward eggs are deposited for the next year's brood. From these eggs caterpillars hatch which feed on the leaves till fall, when they seek sheltered retreats for the winter.

Treatment.— Systematic spraying with arsenicals each year will control this species. The times for effective spraying are, first, as the buds begin to expand and, second, when the leaves are fairly out.

LEAF-ROLLERS.

OBLIQUE-BANDED LEAF-ROLLER,
Archips rosaceana Harris.

FRUIT-TREE LEAF-ROLLER,
Archips argyrospila Walker.

These are native insects that feed upon a variety of fruits, such as apple, pear, peach, plum, and cherry. These insects also attack various shade and forest trees. The leaf-rollers are very destructive to fruit trees during some seasons because of their work on blossoms, young fruits and foliage. The oblique-banded leaf-roller attacks the young apples as soon as they set and continues feeding upon them until the fruit attains nearly an inch in diameter. They eat large round holes, sometimes extending to or even beyond the core.

The larva of the fruit-tree leaf-roller appears as the buds are bursting and feeds upon the unfolding leaves. The leaves and blossom clusters are tied together in a web, within which the larvæ feed. The injury to the fruit is similar to that described for the above associated species. The caterpillars mature in June and the moths appear about one month later. The fruit-tree leaf-roller deposits its eggs on the bark of the trunk and twigs, where they remain through the winter.

Treatment.— Very careful and thorough spraying with arsenate of lead (3 pounds to 50 gallons of mixture) should afford satisfactory protection. The first application should be made shortly after the eggs begin to hatch, which will be when the first green foliage is showing on the trees, and the second as soon as the blossom buds have separated in the clusters. The fruit-tree leaf-roller has proven a very difficult insect to control. Arsenate of lead should be applied as recommended for the associated species. Recent experiments indicate that the insect may be efficiently combated by thorough spraying just before buds open with miscible oil diluted with fifteen parts of water.

APPLE RED BUGS.

Heterocordylus malinus Reut.
Lygidea mendax Reut.

These are small, brilliant red, sucking insects that destroy or deform young fruit. The punctures of the tissues (Plate II, fig. 2) by the insects cause the apples to drop or shrivel upon the tree, or to become pitted and misshapen. (Plate XXVI, fig. 4.) The eggs of the red bug are inserted in the bark of the young wood and they hatch the following spring. The nymphs begin to appear soon after the leaves of the fruit buds open, and hatching is practically completed by the time the blossoms open. The young nymphs feed upon the leaves until the fruit sets, after which they attack the fruit. (Plate XXVI, fig. 3.) The first indication of their presence is minute reddish spots on the terminal leaves which are caused by their feeding. (Plate XXVI, fig. 1.)

Treatment.— The insect may be controlled by spraying just before the blossoms open and again after the petals fall with nicotine extract (Black Leaf 40), using one pint of the extract and four pounds of soap to each 100 gallons of water. These treatments coincide with the 2nd and 3rd applications that are regularly made for scab and codling moth, and fruit-growers are advised to add the nicotine to the lime-sulphur and arsenate of lead. The presence of this insect in the orchard may be determined by placing dormant twigs of bearing wood in water in a warm room after March first, and if eggs of these insects are present, small active red bugs will appear, which will attack the tender leaves.

GREEN FRUIT-WORMS.

(*Xylina* spp.)

These insects sometimes do serious injury by eating into the young apples. They also attack pears, plums, cherries, peaches, and quinces. (Plate XXVII, figs. 1 and 2.) The full-grown caterpillars measure from an inch to nearly an inch and a half in length. They are green or yellowish-green in color with various irregular markings and stripes, the most prominent of the latter being a narrow, cream-colored one down the middle of the back and a wider one along each side. The caterpillars are most destructive during May, soon after the fruit has formed. They continue feeding until about the middle of June. They feed mostly at night, resting on the undersides of the leaves during the day. When full grown they go into the ground, form a rough cocoon and pupate. The adults are dull-colored moths, measuring about two inches from tip to tip with the wings spread. They lay their eggs in the spring, and the caterpillars appear during the early leafing period.

Treatment.— These insects are difficult pests to combat when once they have acquired a taste for the young fruits. They are, however, much less destructive in orchards that are well sprayed each year and given careful attention in other respects. Observations indicate that the most satisfactory means of protecting the crop is thorough spraying with arsenicals before blossoming and after petals drop. Cultivation is unquestionably fatal to many of the pupæ in the ground.

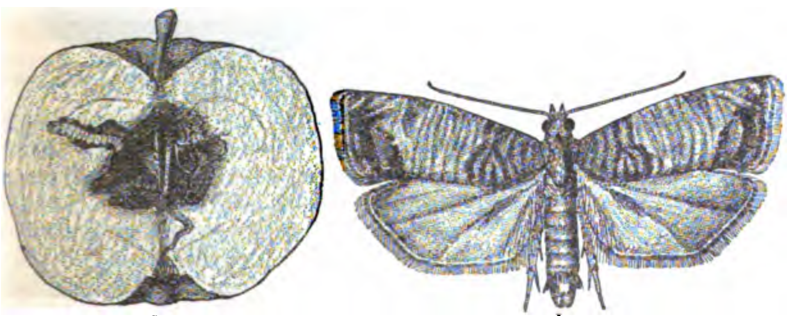


FIG. 48.— CODLING MOTH WORK IN APPLE (a) AND ADULT MOTH (b).

CODLING MOTH.

Cydia pomonella Linn.

This is the insect that causes " wormy " apples. The eggs, which are whitish, oval discs, are laid promiscuously upon the fruit or even upon the twigs and leaves. They hatch two or three weeks after blossoming. A large proportion of the caterpillars enter the fruit at the blossom end. (Fig. 48, a.) The caterpillars of the second brood

often enter on the side of the fruit. They are full grown in twenty to thirty days. When once within the fruit they usually remain until ready to pupate. The cocoons are made in any convenient, protected place, as under the loose bark of the trunk or larger branches of the tree, or in nearby rubbish. Some of the caterpillars remain in the cocoons over winter, while others soon transform to moths, forming a more or less complete second brood of caterpillars. These are sometimes very abundant in late summer and in autumn. The adult is a small brown moth measuring about three-fourths of an inch from tip to tip when the wings are spread. (Fig. 48, b.)

Treatment.— The most efficient means of control is an application of arsenate of lead within one week after blossoming. The spray should be directed downward into the blossom end of the young apple. The calyx end of the fruit should be filled with poison before the calyx lobes close, hence much pains should be taken to make at least one thorough application before that occurs. In addition to the above treatment many fruit-growers make an application of lime-sulphur and arsenate of lead to control the second brood of larvæ and to prevent late infection of apple scab during the latter part of July or early in August, according to seasonal conditions.

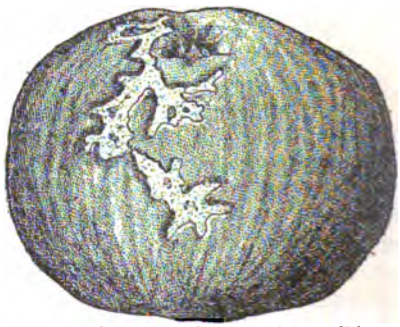


FIG. 49.— WORK OF LESSER APPLE WORM.

LESSER APPLE WORM.

Enarmonia prunivora Walsh.

The lesser apple worm is a native insect which feeds upon crab-apples and wild haws and has recently attracted attention because of its injury to apples. In some sections its work is equally important with that of the codling moth, to which it is similar in habits and nature of injury. The young caterpillars eat cavities or holes one-fourth to one-half inch deep into the flesh, usually about the calyx lobes. They may eat directly through the skin of the young fruit, but more commonly the calyx cavity is the place of entrance. A characteristic feature of their work is the winding blotch mine under the skin of the apple. (Fig. 49.) The mines occur on the sides of the apples, especially where two are in contact or where an apple is touched by a leaf. Later in the season the injury to the blossom end is about the same, though there is a tendency on the part of the larva to penetrate deeper into the fruit, often to the core. The surface injury is rather more common, the larva eating out just under the skin large irregular winding or blotch mines. Larvæ of this species apparently do not reach full development as early in the fall as those of the codling moth, and many find their way into

barrels where they continue to feed, occasionally doing considerable damage. The larvæ are small, flesh-colored caterpillars, measuring about three-eighths of an inch long and are easily confounded with those of the codling moth. The moth is about one-fourth inch long, generally of a rusty red color with black and grayish markings.

Fig. 50.— Palmer Worm Moth.

Remedies.— The insect is controlled by the same treatments as recommended for the codling moth.

PALMER WORM.

Ypsolophus pometellus Harr.

This is another caterpillar which in occasional years causes severe injury to fruit and foliage of apples. It skeletonizes the leaves and eats large irregular holes in the fruit. (Plate XXVII, fig. 3.) The larvæ appear in early June and work over a period of about three weeks. When disturbed they are very active creatures and drop suddenly from the leaf or fruit, suspending themselves in midair by a web. The adults appear in July. (Fig. 50.)

Treatment.—The insect is not important in orchards that are regularly sprayed. The applications of arsenate of lead for the codling moth just after blossoming and two or three weeks later afford complete protection from injury.

PLUM CURCULIO.

Conotrachelus nenuphar Herbst.

This insect is largely responsible for wormy plums and peaches. It also causes deformed and knotty apples and pears. The adult is a small gray beetle that passes the winter under the bark of trees or under rubbish. This insect appears early in spring and deposits its eggs in young fruits. (Fig. 51.) The egg is inserted under the skin, after which a crescent-shaped cut is made around one side of the puncture, as in Fig. 52. Egg laying continues for about two months.

Fig. 51.—Plum Curculio and Work on Fruit.

Treatment.— The plum curculio is rarely injurious to commercial plantings of apples in New York except where the orchard is adjacent to woods, brush land or other favorable hibernating quarters or to plantings of plums and peaches. The most effective means of combating this pest in apple orchards are spraying with lead arsenate, clean cultivation, tillage, and destruction of windfalls. It is possible to reduce the numbers of the insects in nearby plantings of plums and peaches by jarring the plum or peach trees or by spraying with arsenate of lead just after blossoming. If the infestation is due to the presence of woods or waste land such places should be cleared of the underbrush or burned over during the winter to destroy the hibernating insects.

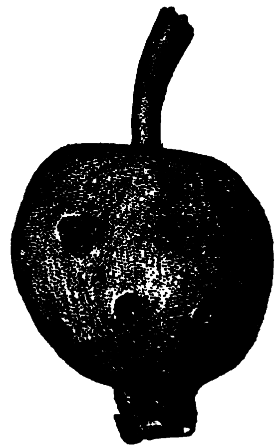


FIG. 52.— CURCULIO PUNCTURES ON YOUNG APPLE.

THE WHITE MARKED TUSSOCK MOTH.

Hemerocampa leucostigma Sm. & Abb.

This insect is primarily a shade-tree insect, but in occasional years it appears in destructive numbers in fruit plantings. The caterpillars attack both fruit and foliage. Pears and apples sustain the greatest injury. In their attacks upon these the caterpillars may eat portions of the skin or gnaw cavities of varying size and depth in the young fruits. The insect lives through the winter in the egg and in this latitude the caterpillars hatch sometime during the latter part of May. It takes twenty-five to thirty-one days for the caterpillars to complete their growth. The insect remains in the pupa stage from ten to fifteen days. At the end of this time the female emerges from the pupa and after mating deposits her eggs upon the discarded cocoon.

Remedies.— Thoroughly coating the foliage when the "calyx spray" is made for the codling moth just after the petals fall will ordinarily prevent injury. However, if the caterpillars are found to be injurious to the fruit, further damage can be prevented by applying a tobacco spray as directed for the red bug on page 374. A severe outbreak of this pest in fruit orchards can be prevented by collecting and destroying the eggs during the dormant season. The eggs are deposited in clusters and appear as a mass of white froth about one-half inch wide and an inch to an inch and a half long. Most of the clusters of eggs are located in plain view on the trunks and branches of the trees where they may be easily picked off and destroyed.

Plate XXV.—Work of Pistol Casebearer and Bud Moth.

1, Pistol casebearers on twig, with injured leaves; 2, larva of bud moth on injured leaf; 3, nest or webbed-leaf retreat of bud moth larvæ.

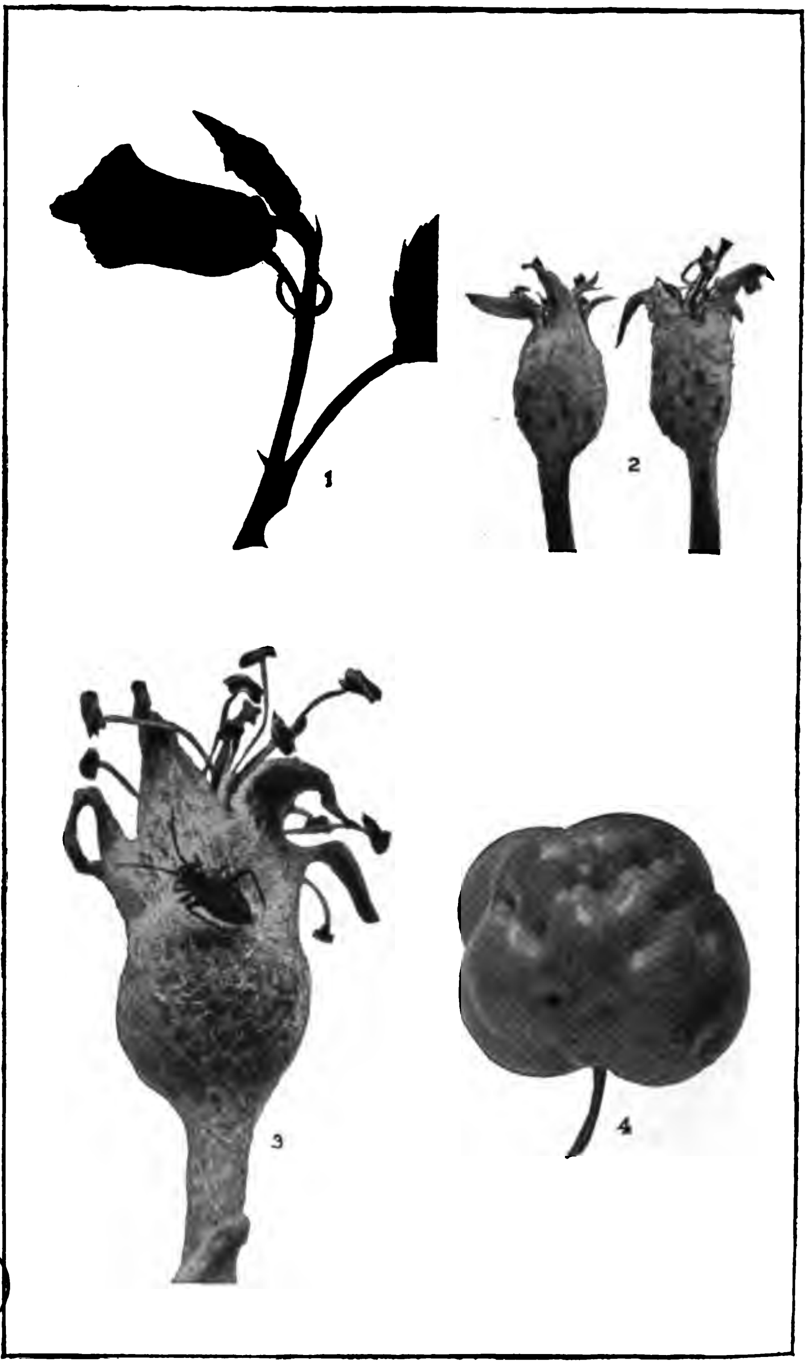


PLATE XXVI.—THE APPLE RED BUG AND ITS WORK.
Red pimpling of leaves due to feeding of nymphs; 2, injuries to forming fruit; 3, red bug on young fruit; 4, apple deformed by work of red bug.

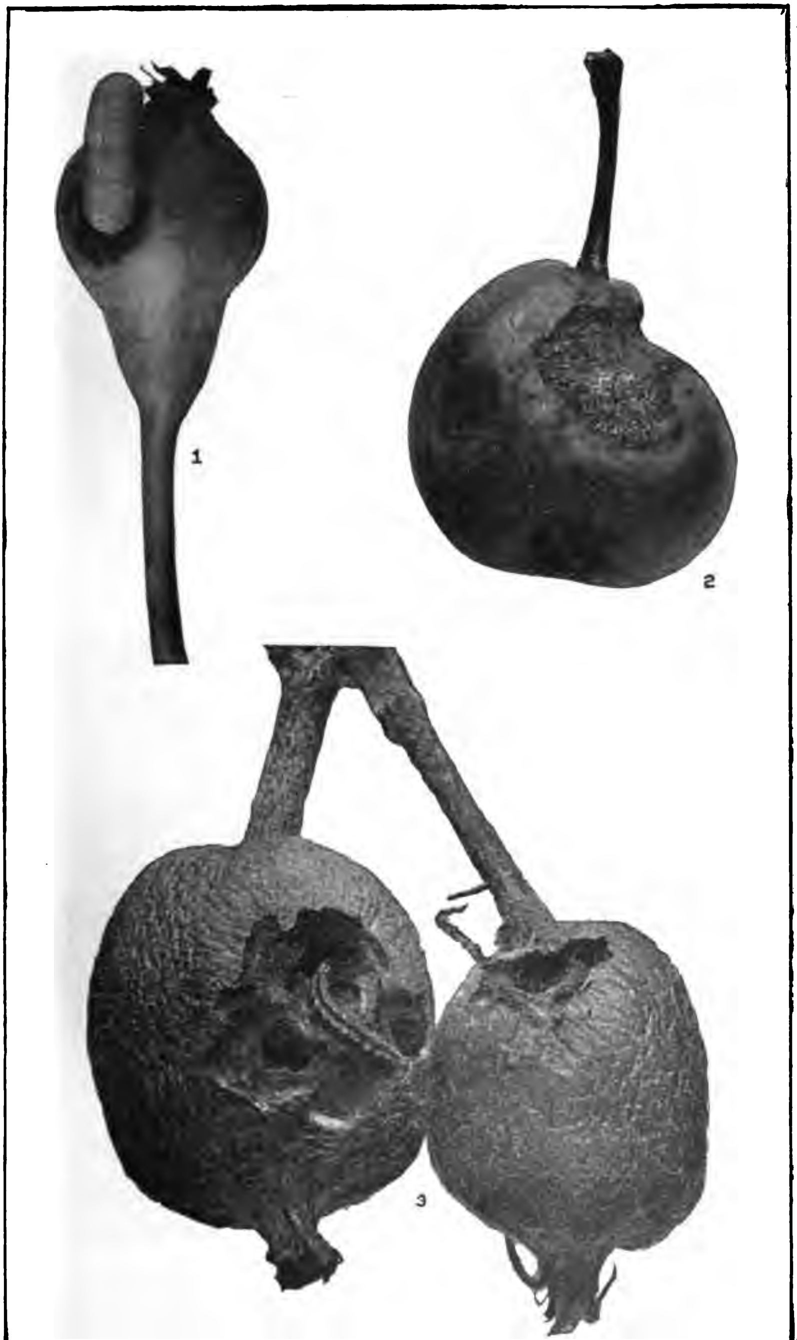


PLATE XXVII.—WORK OF GREEN FRUIT-WORM AND PALMER WORM.
1 and 2, Green fruit-worm and its work; 3, palmer worm feeding on young apples.

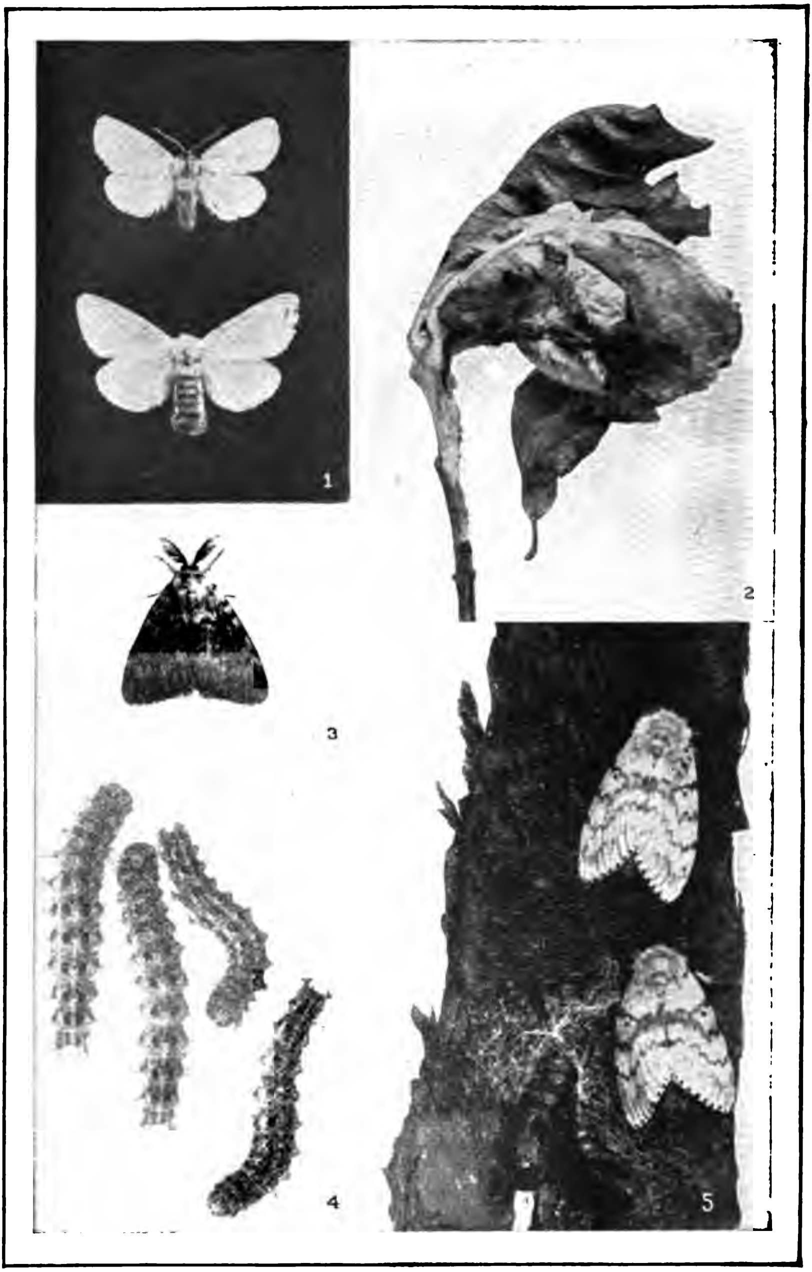


PLATE XXVIII.—GIPSY AND BROWN-TAIL MOTHS.

1, Brown-tail moths, upper male, lower female; 2, winter nest of brown-tail moth caterpillars; 3, male gipsy moth; 4, gipsy moth larvæ; 5, female gipsy moths.

APPLE MAGGOT.

Rhagoletis pomonella Walsh.

In addition to being called the apple maggot, the insect is also commonly known as the railroad worm because of the long, winding, brownish channels made by the larvæ or maggots in the fruit. The adult insects are flies. (Fig. 53.) They appear in June and deposit eggs just under the skin of the fruit. These eggs hatch into maggots that burrow irregular channels through the fruit. (Fig. 54.) Moderately infested fruit becomes rough and uneven due to the "stings" or egg punctures of the fly. Badly infested fruit falls early and the maggots enter the soil, where they remain until the following spring. While many varieties of apples are subject to attack, the injuries are more pronounced to certain sorts that mature in the summer and fall.

FIG. 53.—ADULT OF APPLE MAGGOT.

Remedies.— It has long been noticed that commercial orchards that are cultivated and thoroughly sprayed are as a rule free from injury by this maggot. Neglected orchards, particularly of summer and fall varieties of apples, are susceptible to losses every year. This is especially true in localities where little attention is given to fruit-growing. In this lies a hint that thorough spraying and cultivation of orchards each year as practised by our most successful growers are, perhaps, the most satisfactory means of avoiding injury by this pest. The only remedy that experience has shown to be effective in reducing the injury on badly-infested varieties is the destruction of windfalls, which is ordinarily accomplished by pasturing the orchard with hogs or sheep. Recently the use of poisoned bait has been recommended for the destruction of the fly. The method employed is to syringe the lower branches with a mixture of molasses one pint, arsenate of lead three ounces and water four gallons.

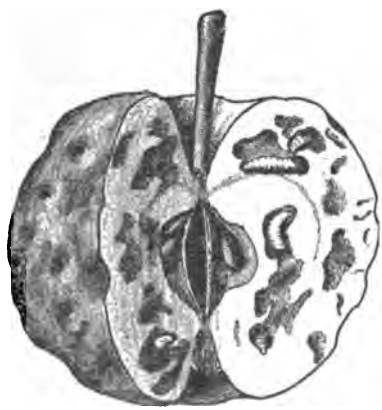


FIG. 54.—WORK OF APPLE MAGGOT.

GIPSY AND BROWN-TAIL MOTHS.

These insects have been for many years destructive pests in New England. They are very injurious in orchards, but they have largely derived their reputation as noxious insects from their ravages on shade and woodland trees. One small infestation of the gipsy moth has already been located in this State; and because of the commercial intercourse and the close proximity of New York to the infested areas of New England the time is doubtless not far distant when one or both of these insects will establish themselves in our fruit-growing sections. Orchardists should familiarize themselves with the appearances and habits of these insects.

GIPSY MOTH.

Porthetria dispar Linn.

The gipsy moth is a native of Europe. It occurs there in destructive numbers at intervals of several years, when it defoliates large areas of forest. It was first introduced into Massachusetts in 1868 and by 1890 it had spread and become a serious pest in the eastern part of the state. In subsequent years it has established itself in many parts of New England and the authorities have undertaken extensive means of repression. The spread of the gipsy moth from one tree to another of its own accord is largely dependent upon the caterpillar stage (Plate XXVIII, fig. 4), for the female (Plate XXVIII, fig. 5) does not fly readily. However, all stages of the insect may be transported by other agencies, such as wagons, automobiles and shipments of freight. By this means the pest has been distributed over the eastern part of Massachusetts and into adjoining states. The caterpillars feed on the foliage of practically all plants, and if uncontrolled will kill most shade trees in two or three years. Coniferous trees are said to be killed after one defoliation.

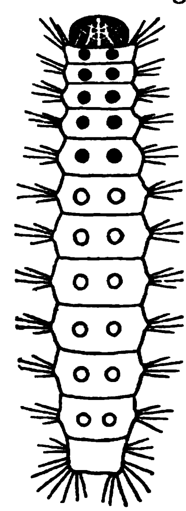


FIG. 55.—DIAGRAM OF MARKINGS ON GIPSY MOTH LARVA.

Life history.—The eggs are laid during July and August in large, oval masses, covered by yellowish hairs from the body of the female. They may be deposited on the bark or in cavities of the trunk, on the underside of leaves, on fences, walls or houses, and on boards, boxes or any kind of object that adjoins infested trees. The eggs hatch about the first of May and the caterpillars are full grown by midsummer. They are then about three inches long, of a dusky color with a double row of eleven spots down the back; the first five pairs are blue and the remaining six red. (Fig. 55.) In July or early August they change to the pupa stage, which is often enclosed

in a thin cocoon. The moths emerge in late July and August. The males, which are smaller and dark brown, fly about and mate with the females, which are nearly white with dark markings and are heavy bodied and scarcely able to fly.

Remedies.— Paint egg clusters with creosote in fall, winter or spring. Spray trees with arsenate of lead (5 lbs. per barrel) just as the eggs are hatching in the spring.

BROWN-TAIL MOTH.

Euproctis chrysorrhœa Linn.

The brown-tail moth was introduced into the United States in 1890 on nursery stock imported from Europe, where it is a common native pest. It first became established in eastern Massachusetts and has since spread to New Hampshire, Maine, New Brunswick, Connecticut, and Rhode Island. The moths (Plate XXVIII, fig. 1) fly long distances and spread mostly with the prevailing winds. It has not become established in New York so far as is known, but thousands of nests have been found by nursery inspectors on seedlings imported from France. The caterpillars of this species prefer the fruit trees, but they also feed on almost all the common forest trees except the evergreens.

Life history.—The moths emerge in midsummer. The eggs are laid in late summer on the terminal leaves. The caterpillars are gregarious and pull the leaves together with a web, forming tough silken nests in which they pass the winter (Plate XXVIII, fig. 2). When they emerge in the spring they feed on the opening buds and leaves and become full grown in June. The mature caterpillars are covered with fine barbed hairs which cause a distressing irritation of the skin upon human beings, known as the " brown-tail rash ". The pupæ are found among the leaves enveloped in white-silk cocoons. Both sexes of the moths are white on all parts except the abdomen, which is covered with brown hairs.

Remedies.— The measures employed to combat the insect are as follows: Cut off nests from trees from October to April and burn them. Spray trees during early May and in August, when the eggs hatch, with arsenate of lead.

SPRAYING SCHEDULE FOR THE PRINCIPAL INSECTS AND DISEASES OF THE APPLE.

First application.— As buds show green at the tips, use lime-sulphur wash at winter strength for San José scale and leaf blister-mite.

Second application.— Just before blossoms open, for apple scab and various leaf-eating insects, use lime-sulphur solution (32° Beaume) diluted with forty parts of water, with two to three pounds arsenate of lead to forty gallons. May be omitted if insects are few and weather is dry.

Third application.— When blossoms are about two-thirds off, give same treatment as (2). This is the most important spraying for apple scab and codling moth. Should never be omitted.

Fourth application.— About two weeks later repeat (2) if weather is favorable for apple scab; that is, moist and warm.

Fifth application.— About first week in August repeat (2) to prevent late infections of apple scab and to control second brood of codling moth.

REPORT

OF THE

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[1] Resigned September 15, 1913.
[2] Appointed September 1, 1913.

REPORT OF THE DEPARTMENT OF HORTICULTURE.

APPLES: OLD AND NEW.*

U. P. HEDRICK AND G. H. HOWE.

INTRODUCTORY.

The culture of new varieties is looked upon by conservative fruit-growers as gambling, pure and simple. Several causes combined put this stigma on new fruits: Introducers outrun all license in describing their wares; nurserymen too often rename old varieties; and, more than all else, originators, nurserymen, and fruit-growers have wrong ideals and introduce varieties without value or to fill places better occupied by existing sorts which cannot be dislodged.

Yet despite the hazards, novelties must be grown if fruits are to be improved. There are many notions current that old varieties can be changed for the better but the statements to this effect far outstrip the evidence. Varietal improvement has been and will probably remain a negligible factor in obtaining better fruits and new varieties must be grown to keep up the evolution which each generation has seen in fruits and which will continue indefinitely since the limits of improvement can never be reached.

Old varieties are novelties in new locations as they are also to all who have never grown them. The introduction of new sorts and the uncertainty as to old ones makes it necessary for some one to grow varieties on probation in fruit-growing regions. Now to test varieties of fruits is a money-taking, time-consuming task which requires not only the good judgment of an expert fruit-grower but wide and thorough knowledge of varieties. Manifestly, it is work for an experiment station and not for an individual.

The New York Station attempts to test every variety of fruit obtainable that will thrive in this climate. This bulletin is one of several publications from this Station giving results of tests of old and new apples. It is the latest answer to the oft-repeated question: "What apples shall I plant?"

* Reprint of Bulletin No. 361, March, 1913; for Popular Edition, see p. 730.

The most valuable information for the grower is to be found in the catalog of apples on the last pages of the Bulletin. Studying the varieties under test has thrown light on several phases of apple-growing, some of them more suited to controversy than practice yet worth taking into account, and these are discussed before the catalog is reached under the heads: Groups of Apples, Strains of Apples, Do Apples Degenerate, Natural Resistance to Disease in Apples, and Seedless Apples.

GROUPS OF APPLES.

Horticultural writers very commonly divide apples into vaguely-defined divisions called "groups." This term, like "kinds," "strains," "races," and "sorts," has no official recognition in the botanical or horticultural codes of nomenclature, and since the codes of botany and horticulture are already complex even to experts, it would be confounding confusion to add this term officially. But we can hardly expect to have uniformity in the nomenclature of plants, wild or cultivated; and since "group" is a word of great convenience to fruit-growers and is understood alike by those who use it and those to whom it is addressed, convenience, in this case, can well be put before principle and the use of "groups" be continued.

The limits of the term are easily set; indeed, its application is so apparent in pomology that it hardly needs defining. A *group* is a collection of varieties of a fruit which has so many characters in common that near kinship is apparent. Members of groups of apples usually have a common ancestor, one, two, or at most, three generations back. So used, a group is a fraction of the species, the true botanical unit, and a variety is a fraction of the group.

The formulation of varieties of apples into groups in accordance with their blood relationships is, in one particular, at least, of prime importance to apple-growers; since groups of apples have marked adaptations to particular conditions. Thus, the Winesap, Romanite and Ben Davis groups are preeminently adapted to

southern apple regions; the Fameuse, Blue Pearmain, Reinette and Baldwin groups to New York; and the crab-hybrid group, represented by Wealthy, and the Russian apples, for the north Mississippi Valley. This development of groups of related varieties for regions having diverse conditions is becoming more and more marked and in New York we can discard whole divisions from the State and in the State can assign certain groups to certain pomological districts. Grouping varieties, then, is not only a means of classification but is a real help many times as a guide to apple-growers in seeking what to plant.

Groups are by no means fixed units. If the species of fruits were fixed they might be divided into parts that would be definite. But species are "judgments," to use an oft-quoted saying of Asa Gray, and the division of the apple species must also be an act of judgment, the value of which depends upon the knowledge of the judge. The groups of apples which follow, then, are tentative, subject to modification, and are presented chiefly as a means of showing the adaptations of varieties.

GROUPS OF APPLES.

Aport group.— Large, handsome, fall apples, coarse in texture and of medium quality. Some members of the group are adapted to all parts of New York.

Alexander,	Bismarck,	McMahon,
Ananarnoe,	Constantine,	Thompson,
Aport Orient,	Great Mogul,	Wolf River.
Arabka,	Howard Best,	
Bietigheimer,	Judson,	

Baldwin group.— Highly colored, long keeping, well flavored, rather large apples with similarities in texture, flavor, form and color markings. Trees winterkill in the northern districts but are well adapted to all other districts.

Arctic,	Barber,	Red Russet (red strain of Baldwin),
Babbitt,	Hunterdon,	Sutton,
Baldwin,	Olympia (identical with Baldwin),	Tufts.
Bayard,		

Ben Davis group.— Rather large, bright red, coarse and solid in texture, indifferent flavor, thick skin, shipping well and keeping well.

Arkansas Beauty,
Beach,
Ben Davis,
Black Ben Davis,
Challenger,
Chicago,
Coffelt,
Collins,
Dickinson,
Eicke,
Florence,
Gano,
Saratoga,
Schenectady,
Shackelford,
Shirley,
Wallace Howard.

Black Gilliflower group.— Medium sized, dark red, oblong, ribbed apples of good quality but rather dry and coarse in texture. Less hardy than the Baldwin group. Particular as to soils.

Black Gilliflower,
Deacon Jones,
Johnsonite,
Lady Finger,
Scollop Gilliflower,
Skelton,
Striped Gilliflower.

Blue Pearmain group.— Somewhat large, dull red with bluish bloom, mild flavor, fair quality, dense texture and thick skins. Adapted to northern conditions and for most part valuable there only.

Baxter,
Bethel,
Blue Pearmain,
Du Bois,
Gideon Sweet,
Jewett Red,
Mabie,
Monroe Sweet,
Oel Austin,
Perry,
Perry Red,
Rutledge,
Scarlet Beauty,
Stone,
Victoria Sweet,
Windsor.

Chenango group.— Medium sized, red striped, oblong conic apples of high quality, peculiar aroma and delicate texture. In general the three sorts in this group succeed where the Baldwin can be grown.

Chenango,
Prince Double,
Stump.

Early Harvest group.— Summer apples of medium size, pale yellow or white in color, of good but not superior quality and with delicate breaking flesh. More suitable to the warmer than to the colder portion of the State.

Early Harvest,
Early Ripe,
Parry White.

Fameuse group.—Medium sized, handsome red, usually striped, apples, roundish oblate, thin skinned, of high dessert quality, and

pure white tender flesh. A tendency to reproduce true from seed is a striking peculiarity. As a group, predisposed to fungus troubles. The varieties in this group, with one or two exceptions, reach their highest perfection in the North. The most valuable group for the colder portion of the State.

Boys Delight,	**Jersey Black,**	**St. Lawrence,**
Canada Baldwin,	**La Victoire,**	**Shiawassee,**
Cortland,	**Louise,**	**Striped Fameuse,**
Detroit Red,	**McIntosh,**	**Switzer,**
Fameuse,	**Onondaga,**	**Scarlet Pippin,**
Hilaire,	**Otsego,**	**Ver.**

Hibernal group.— Probably the hardiest apples. Mature in a short season. Russian.

Bogdanoff Glass,	**Hibernal,**	**Ostrakoff,**	**Romna.**

Jonathan group.— Medium sized, handsome red apples of high quality, and crisp, juicy flesh. Variable in adaptations. Resembles the Baldwin group. With one or two exceptions best adapted to the Eastern districts.

Esopus,	**King David,**	**Red Canada,**
Flushing *Spitzenburg*,	**McCroskey,**	**Rensselaer,**
Jonathan,	**Manchester,**	**Rockland.**
Kaighn,	**Mother,**	

Keswick group.— English apples of unknown adaptations in New York.

Keswick,	**Lord Suffield.**

Lady group.— Very small, roundish oblate, dessert apples, handsome in color and sprightly in quality, with crisp, juicy flesh, thin skin, and good keeping qualities. Best adapted to the Hudson Valley and Long Island districts.

Highland,	**Peron,**	**Star Lady.**
Lady,	**Sleight,**	

Lawver group.—Medium sized, of very high color, rather dense, medium coarse texture and inferior flavor. Excellent keepers. From the South, but Akin, at least, is worth trying in the milder parts of New York.

Akin,	**Lawver,**	**McAfee.**

Limbertwig group.— From the Southwest and not adapted to New York conditions.

Green Limbertwig,	Red Limbertwig.

Longfield group.— Russian, and can be grown in practically all parts of New York.

English Pippin,	Longfield.

Lowland Raspberry group.— Russian. Adapted to Northern New York.

Lowland Raspberry,	Red Wine.

Newtown Spitzenburg group.—Medium sized, roundish, striped apples of high quality. Running small in New York and not well adapted to any of our districts.

Bethlehemite,	Duncan,	Newtown Spitzenburg.

Northern Spy group.— Large, striped red, roundish oblate, ribbed, with delicate bloom, juicy, crisp, fine grain, of highest flavor and quality. Fastidious as to soils but probably can be grown in congenial locations in all but the coldest portions of the State.

Arnold,	Northern Spy,	Stanard,
Doctor,	Ontario,	Wagener.
Hagloe,	Oswego,	
Melon,	Schoharie,	

Oldenburg group.— Medium to above in size, variously striped with red, generally ripening in fall and of comparatively short season. Tart, culinary apples with but few dessert sorts. Russian. Probably the most cosmopolitan of the groups here listed — some members succeeding in all parts of New York.

Anis Rose,	Falix,	Okabena,
Autumn Streaked,	Gladstone,	Oldenburg,
Borovinka,	Golden White,	Pewaukee,
Buda,	Hoadley,	Striped Winter,
Champaign,	Lead,	Zolotareff.
Charlamoff,	Lou,	
Dudley,	Milwaukee,	

GRAVENSTEIN SECTION.

Banks,	Gravenstein.

Ralls group.— On mature trees medium to below in size, rather dull striped red, of superior quality and texture, keeping late, productive to a fault. A southern group not adapted to northern conditions.

Doctor Walker,	**Milam,**	**Salome.**
Ingram,	**Ralls,**	

Rambo group.— Only medium in size, roundish oblate, rather dull striped red, good quality. Southern. Adaptations not well known for New York, though some members of the group can be grown in the warmer districts of the State.

Domine,	**Milden,**	**Wells.**
Lacker,	**Rambo,**	

Red Astrachan group.— Summer apples of above medium size, crisp, tart and of good quality. May be grown in all parts of the State.

Oszi Vaj,	**Red Astrachan,**	**White Astrachan.**

Reinette group.— With few exceptions rather large in size, of green or yellow ground color, with or without blush, and generally of good quality. A large and poorly defined group which is here divided into four sections. Nearly all of the members, with the exception of a few in the Newtown Section, thrive in New York. Only a few varieties of this group, however, succeed in the northern district.

FALL PIPPIN SECTION.

Albion,	**Greenville,**	**Peach Blow,**
Boiken,	**Hawley,**	**Reinette Pippin,**
Crowns,	**Holland Pippin,**	**Sharp,**
Elgin Pippin,	**Jack,**	**White Spanish,**
Ewalt,	**Lowell,**	**Winter Banana,**
Fall Harvey,	**Maiden Blush,**	**Winter Pippin,**
Fall Pippin,	**Magenta,**	**York Pippin.**
French Pippin,	**Newark Pippin,**	
Golden Pippin,	**Ohio Pippin,**	

RHODE ISLAND GREENING SECTION.

Autumn Swaar,	**Holland Winter,**	**Sheddan,**
Battyani,	**Monmouth,**	**Starr,**
Bottle Greening,	**Northwestern Greening,**	**Sweet Greening,**
Canada Reinette,	**Patten,**	**Tobias Pippin,**
Fall Orange,	**R. I. Greening,**	**Victuals and Drink.**

NEWTOWN SECTION.

Admirable,	Ivanhoe,	Slingerland,
Belmont,	Middle,	Westchester,
Clinton,	Peck *Pleasant*,	White Pippin,
Green Newtown,	Perry Russet,	Yellow Newtown.
Grimes,	Pickard,	
Huntsman,	(I) Shannon,	

SWAAR SECTION.

Mann,	Seneca Favorite,	Swaar.

Romanite Group.— Variable in size, highly colored, from poor to good in quality, keeping very late. Southern apples of little value in New York with the possible exception of one or two sorts for the warmer districts.

Buckingham,	Minkler,	Pennock,
Gilpin,	Missing Link,	Romanite,
Glenloch,	Mock,	Stark,
Lansingburg,	Nero,	York Imperial.

Rome group.—Above medium in size, roundish, handsomely colored apples of indifferent quality. Rome, only, succeeds in some parts of New York.

Ben Hur,	Langford,	Rome.

Russet group.— Ranging from small to above medium in size, russet colored, with peculiarly fine-grained, dense texture. sprightly flavor and good keeping quality. Illy defined as to adaptations but some member succeeding in all of the New York districts.

Brownlees,	Golden Russet,	Roxbury,
Bullock,	Hunt Russet,	Sailee Russet,
Carpentin,	Long Island Russet,	Swayzie,
English Russet,	Pomme Grise,	Sweet Russet.

Summer Rambo group.— Large, attractively striped with red, roundish oblate, coarse in texture, and of average quality, ripening in early fall. Adaptations not well defined for New York.

Grosh,	Summer Rambo,	Western Beauty.

Sweet Bough group.— Summer or fall apples of sweet flavor, medium to large size, variably conic, good quality. Very general in adaptations, although some of the members cannot be grown in cold localities.

Autumn Bough,	Fullerton Sweet,	Sweet Bough.

Tetofsky group.— Summer apples, below medium in size, striped, of average quality. Valuable only in cold climates.

July,	Tetofsky.

Tompkins King group.— Early winter apples, large, attractively striped with red, variable but symmetrical in form, of superior quality and characteristic dense, coarse texture and aromatic, yellowish flesh. Especially suited to the western New York districts, but succeeding to a fair degree in all except the most northern districts.

Adirondack,	Halt,	Palouse,
Blenheim,	Hubbardston,	Ribston,
Ensee,	Ozone,	Tompkins King.
Fishkill,		

Twenty Ounce group.— Large, late fall, broadly splashed red apples, roundish in form, of good quality and with a coarse, yellowish, aromatic flesh. Grown more or less generally in all but the most northern districts.

Collamer,	Lyscom,	Twenty Ounce.

Vandevere group.— Local in adaptation and confined mostly to the warmer part of the State.

Ronk,	Vandevere,	Vandevere Improved (identical with Vandevere).

Wealthy group.— Fruit undersized on old trees. Early and abundant croppers. Hardy and adapted to all of the apple districts of New York.

Peter, Wealthy, and several Minnesota seedlings.

Winesap group.— Winter apples, medium to large in size, dark red, rather solid and of fine grain, of good but not high quality,

good keepers. A group belonging to the South and West and of small importance in any of the apple districts of New York.

Arkansas,	Oliver,	Winesap,
Arkansas Black,	Paragon,	Winter Paradise.
Kinnaird,	Stayman Winesap,	

Yellow Bellflower group.— Medium to large apples, characteristically oblong conic, predominantly yellow, with a large somewhat remarkably open core. Flesh firm, crisp, aromatic and of high quality for culinary purposes. Somewhat general in distribution throughout the State but inclining to the southern and warmer districts.

Barry,	Moyer,	Summer Bellflower,
Flory,	Newman,	Titus Pippin,
Kirtland,	Occident,	Yellow Bellflower.
Mason Orange,	Ortley,	

Yellow Transparent group.— Early summer apples, of medium size and characteristically thin skin and tender flesh. Russian. Adapted to all New York districts.

Breskovka,	Red Transparent,	Thaler,	Yellow Transparent.

STRAINS OF APPLES.

As dividing the species into groups of varieties helps in determining adaptations and, therefore, what to plant; so, the division of the variety into strains may be helpful if the strains are real and not fanciful — as proves so often to be the case. Strains arise through bud variations, long known to fruit-growers as sports, but recently dignified by De Vries as mutations. Strains so arising, in apples, in particular, usually differ from the parent variety in one or at most but a few characters. Color of fruit seems to be the character which is in a mutating condition in apples; and nearly all of the strains of this fruit differ from the parent only in color. The touchstone which Nature uses in creating new characters in plants has not yet been discovered and there are no known means whereby a variety may be made by man to sport or mutate.

Three varieties out of the 804 catalogued in this Bulletin have probably originated as bud-mutations. Each of these three differs from its parent only in the color of the fruit and ought to be rated as a strain rather than as a distinct variety. Each not only so strongly resembles the parent as scarcely to be distinguished from it, but answers the same purpose, is adapted to the same environment and will probably sell in the markets under the parental name, though in two of the three cases the apples ought to sell better by reason of the higher color.

The three apples are Banks, a bright red mutation of Gravenstein, Collamer, a highly colored offshoot of Twenty Ounce, and Red Russet, the well known russet variation of Baldwin. The first two strains are improvements on the parents but the russet Baldwin has no merits superior to its parent. In the last case, at least, the strain is not well fixed, since buds from Russet Baldwins occasionally produce normal Baldwins and individual trees are reported in which part of the product is russet and the remainder the normal red.

It is possible that Green and Yellow Newtown and Black Ben Davis and Gano are related as parent and mutant offspring. At the most, however, there is only the slightest possible distinction — a case of tweedledum and tweedledee — in either of the two pairs. In neither pair is there a claim as to which was parent or which offshoot. The high color in Yellow Newtown and Black Ben Davis, if it exist, would in most markets be a commercial asset.

As the writer has tried to show elsewhere,[1] deviations from type which can be perpetuated are exceedingly rare. Fluctuating variations due to environment there are in countless numbers, but these are not known to be transmitted and probably disappear with a change in environment.

The introduction of some fluctuating variation or a new variety is not uncommon in apples, this catalog furnishing several examples. Thus, Improved Wagener, heralded as a "pedigreed" strain of the common Wagener differs not a whit from its parent

[1] N. Y. Agr. Expt. Sta. Bul. 350: pp. 146 to 151. 1912.

on our grounds; Olympia, another "pedigreed" marvel of the press "bred up" from the Baldwin is a "chip off the old block," a typical Baldwin, as it grows here; Improved Shannon and Improved Vandevere are other examples of "pedigreed strains" in which no improvement can be found when the trees are grown side by side with the parents. These are but a few examples cited to lead up to a caution several times sent out from this Station in the past few years: Fruit-growers should steer clear of "pedigreed stock" and "improved strains" of varieties until the new productions can be seen somewhere by competent judges growing side by side with the parents. So far, improved strains have turned out to be better suited to advertising than to the needs of fruit-growers.

DO APPLES DEGENERATE?

We are not breaking new ground in considering this question, as it is at least a century old. Knight, foremost of horticulturists a hundred years go, maintained that varieties of cultivated plants deteriorate with age. He held that, since all the individuals of any variety of a plant propagated by vegetative means are only parts of one original plant, however greatly multiplied or widely scattered, all must simultaneously approach old age and death. There has been scarcely a horticulturist of note since who has not pronounced for or against Knight's view, in some one of its many phases. If plant-growers were allowed to settle the controversy the verdict would be unanimous that "varieties do degenerate." But the trend of science is against degeneration of varieties.

Science says that varieties retain their characters permanently, suffering deterioration neither from old age nor oft-repeated vegetative reproduction. Cells and plants may die in millions from various causes but individuals retain the power to reproduce the variety indefinitely. Perhaps a qualification to this statement should be made. It is possible that new varieties, especially those arising from crosses, have a first flush of vigor and are more or less unstable, or do not show all of their characters in the first few years of their existence.

It is desirable that experience with a particular plant extending over a long period should be put on record if it have a bearing on this matter of degeneracy. Most of the apples discussed in this Bulletin have been grown on the Station grounds. The origin, history, description and statements of faults and merits from textbooks, the press and correspondents, are on file and in daily use. When all the information from these sources, made plain by familiarity, is focused, stability rather than variation characterizes varieties of apples.

The following varieties, in particular, have been studied in the orchard and in the literature. The Baldwin has been under cultivation since about 1740, yet trees on our grounds, from several sources, show no signs of deterioration. Though Baldwin is the most widely planted apple in America, the whole progeny of the original tree, with the exception of the Russet Baldwin, a mutation, is uniformly the same when grown under identical conditions. A Rhode Island Greening tree in the Station orchard propagated from what is supposed to be the original Rhode Island Greening, about 200 years old, is the same in growth and bears apples no better, no worse, than trees several generations removed from the parent plant. The Roxbury Russet, Lady and Fameuse, all grown for three centuries, show no impairment of vigor or change in characters if we may compare growing plants with the descriptions in old textbooks.

Varieties known to be over 200 years old, beside the three named, trees of which still grow vigorously and produce well, are Ribston, Green Newtown, Holland Winter, Pomme Grise, Winter Pearmain and Yellow Bellflower. Of those over 100 years there are a score or more of well known sorts whose history and behavior are so well recorded as to leave little doubt that they are the same now as in the beginning. If they are wearing out it is a very slow process. Among these are Fall Pippin, Gloria Mundi, Hawley, Williams, Early Harvest, Detroit Red, Oldenburg, Red Astrachan, Maiden Blush, Porter, St. Lawrence, Sweet Bough, Black Gilliflower, Ben Davis, Cooper Market, Domine, Esopus

Spitzenburg, Grimes, Hubbardston, Jonathan, Peck Pleasant, Ralls, Red Canada, Smith Cider, Swaar, Tompkins King, Wagener, Westfield, and Winesap.

The fact that many of the varieties named are less popular than they once were and that other apples famous in their day have disappeared, argues nothing. Varieties thus drop out because they are outclassed by newcomers. Of the sorts named, some will be cited as lacking in vigor, as "losing in constitution." These, it will be found, have been "defectives" or "unmanageables" from the start. It was the great excellency of their product that originally brought them from the limbo of unnamed seedlings. Varieties disappear in localities, too, because they are out of harmony with their surroundings.

The fruit-grower sees individual trees wearing out and jumps to the conclusion that the variety is running down. Individual trees wear out by the million because of neglect, unsuitable soil, insects and diseases. The effects of the causes named can no more be attributed to degeneracy than the ills and ailments of mankind due to poor diet, care and surroundings can be said to come from degeneracy in mankind.

It is true, as every nurseryman well knows, that debility in the parent stock is transmitted in some degree to the succeeding generation — a matter of feed and not of breed — but this effect does not continue through more than a few years if the cause be removed. The weakling from a poorly nourished bud usually outgrows its frailness and none of it is passed on to future generations.

From all evidence to be had it would seem that the fruit-grower is safe in assuming that for practical purposes varieties of apples do not degenerate. Neither do they change. Vigor cannot be permanently increased, nor characters resulting from environment added, by using the sieve of selection. But through the horn of plenty, vigor can be increased for the generation in hand and trees may be made to take on for the time being new and oftentimes valuable characters. Abundance of food,

the best of care, protection against insects, diseases, adverse soil or adverse climate are the means of preventing individual degeneracy which so many fruit-growers confound with degeneration of the variety.

NATURAL RESISTANCE TO DISEASE IN APPLES.

Notes on resistance to the various troubles of apples have been taken in the Station orchard for a number of years and while these, when compiled, make no great showing, yet they do have some value to apple-growers. It means much in selecting varieties to know which are immune or susceptible to an uncontrollable disease, as fire blight; or in the planting of home orchards, where it may not be feasible to spray, a man may well select the sorts that are least susceptible to scab, whereas this disease counts for almost nothing to those who spray. The subject, as one can see after a moment's thought, is a most important one to plant-breeders.

Immunity to contagious disease, or the fact that some animals and plants are more or less secure against infectious germs to which their near of kin are subject, is elementary knowledge alike to those who have charge of the health of humans or of lower forms of life. In spite of a wealth of recent discoveries the causes and conditions of immunity are not well known. With plants, especially, knowledge of causality and condition is a thing of shreds and patches. It is known, however, that there are two kinds of immunity; that which is acquired and that which is inherited.

Immunity in animals is acquired in several ways; as, by having the disease, of which smallpox and measles are examples; by being inoculated with attenuated virus or with some toxic product of the bacteria; and by injections of the serum of some other immune animal. Immunity in plants takes a different turn and it is not known that it can be acquired. Man has smallpox but once, but there is no known parallel in the plant kingdom; though there are cases, as that of pear blight, in which a disease seldom attacks old plants which must have had the disease in their youth. Neither

is it possible to cause immunity in plants by vaccinations, inoculations or injections.

Inherited immunity is possessed by animals and plants alike. Negroes are immune to yellow fever; some cattle and sheep to anthrax; certain pears and apples are immune to blight; some peaches to leaf-curl. Immunity sometimes belongs to species, sometimes to races or varieties and sometimes to individuals.

But while we are in comparative ignorance of how immunity is transmitted we now have a substantial body of facts showing that it can be bred in plants. As far back as 1900, in the medieval days, almost the prehistoric days, of plant breeding, as we view the progress that has since been made, the breeding of disease-resistant plants had been begun and has been steadily carried on since through selection and by crossing. Through selection Blinn [1] has developed a cantaloupe resistant to blight; Bolley [2] has bred a flax resistant to flax wilt; Bain and Essary [3] a red clover that withstands a fungus; Jones [4] has selected a potato resistant to late blight; and Orton [5] has grown a cowpea resistant to a wilt fungus. The work done with these plants should be most suggestive to breeders of apples.

Not so much has been done through hybridizing but still a very promising start has been made. Orton [6] has grown a hybrid between the watermelon and the citron which is resistant to the watermelon wilt, while Biffen [7] has made the most important dis-

[1] Blinn, P. K. A rust-resisting cantaloupe. Colo. Agr. Exp. Sta. Bull. 104. N 1905.

[2] Bolley, H. L. Breeding for resistance or immunity to disease. *Proc. Amer. Breeders' Assoc.* 1: 131–135. 1905.

[3] Bain, S. M., and Essary, S. H. Selection for disease-resistant clover. Tenn. Agr. Exp. Sta. Bull. 75. D 1906.

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[5] Orton, W. A. The wilt disease of the cowpea and its control. U. S. Dept. Agr. Pl. Ind. Bull. 17: 9-22. 1902.

[6] Orton, W. A. A study of disease resistance in watermelons. Science II. 25: 228. 1907.

[7] Biffen, R. H. Mendel's laws of inheritance and wheat breeding. *Jour. Agr. Sci.* 1: 4–48. 1905.

———. Studies in the inheritance of disease resistance. *Jour. Agr. Sci.* 2: 109–128. Ap. 1907.

covery that resistance and susceptibility in one species are Mendelian characters. He has found that susceptibility in wheat to attacks of yellow rust are inherited in Mendelian ratio. If his conclusions are correct, susceptibility to this rust is a unit-character in wheat; immunity depends upon the absence of this character.

Biffen's evidence is such that we are forced to accept it for this disease of wheat. When we supplement his discovery with the knowledge we previously had of inheritance of disease, we are filled with hope that immunity and susceptibility are inheritable characters with many diseases of plants.

It will not do to jump immediately to the conclusion that we shall shortly breed fruits resistant to all fungi and bacteria. The task will be long and laborious for any one disease, as it can be accomplished only by breeding new varieties — old sorts cannot be changed. Varieties having immunities must be crossed with other varieties. With the manifold characters of the two parents, it may require much shuffling and many draws to secure the combination of disease resistance with other characters that a good variety must have.

Meanwhile, not much real building can be done until we have the foundation laid. That foundation must be knowledge of the immunities and susceptibilities of existing varieties. The chief object of this brief discussion of resistance to disease is to introduce a list of varieties of apples which at the Geneva Experiment Station are more or less resistant or susceptible to two diseases — apple scab (*Venturia inaequalis* [Cooke] Aderh.) and apple blight (*Bacillus amylovorus* [Burr.] De Toni).

SUSCEPTIBILITY OF APPLES TO APPLE SCAB.

Relatively immune.	*Relatively susceptible.*
Alexander,	Belmont,
Baxter,	Bellflower,
Ben Davis,	Chenango,
Black Gilliflower,	Esopus Spitzenburg,
Cranberry Pippin,	Fall Pippin,
Gano,	Fameuse,

Relatively immune.	*Relatively susceptible.*
Gravenstein,	Golden Pippin,
Grimes,	Green Newtown,
Hubbardston,	Hawley,
Jonathan,	Huntsman,
Northwestern Greening,	Lady,
Oldenburg,	Lady Sweet,
Red Astrachan,	Lawver,
Rome,	Maiden Blush,
Roxbury Russet,	McIntosh,
Sutton,	Mother,
Swaar,	Northern Spy,
Tolman Sweet,	Ortley,
Tompkins King,	Red Canada,
Wagener,	R. I. Greening,
Wealthy,	St. Lawrence,
Yellow Transparent.	Smokehouse,
	Twenty Ounce,
	Willow Twig,
	Winter Pearmain.

The list below was prepared from notes taken in 1906 when apple blight was more prevalent in western New York than ever before known. Only well known varieties are listed. Sorts intermediate to blight are not listed.

SUSCEPTIBILITY OF APPLES TO APPLE BLIGHT.

Immune in 1906.	*Very susceptible.*
Babbitt,	Alexander,
Baldwin,	Arabka,
Cox Orange,	Bailey Sweet,
Cranberry Pippin,	Bismarck,
Delicious,	Black Gilliflower,
Gideon,	Constantine,
Grimes,	Esopus *Spitzenburg*,
Lady,	Fall Pippin,
Northern Spy,	Jonathan,
Swaar,	Mother,
Sweet Bough,	Pewaukee,
Tompkins King,	Ralls,
Twenty Ounce,	R. I. Greening,
Wagener,	Rome,
Washington Strawberry.	Sutton.

There is another form of natural resistance to disease, too often neglected by plant pathologists and plant-growers alike,

which is too important to let pass without a word. This is the resistance made by strong, able-bodied, well-fed, healthy, vigorous plants. Any and all of the things that contribute to highest vigor in a plant add to its capacity to resist or throw off disease and the reverse condition predisposes to the contraction of disease. There is no experimental evidence in confirmation of the statement just made but it has so much observational foundation that it may be put in positive words.

SEEDLESS APPLES.

Periodically the imagination of fruit-growers is excited by reports of new and wonderful seedless apples. But as yet, the seedless apple is a chimera from the standpoint of utility. The fruits are usually very deficient in size, color or quality — the latter in particular. Most of them are also abnormal in other respects than in fewness of seeds. In many varieties of apples seedless individuals are now and then found. On the other hand there seems to be no known case in which all of the apples in seedless varieties are lacking in seeds.

Seedless apples are not new. They were known to the Greeks [1] and the Romans. They have been described time and time again since Pliny [2] wrote of Roman agriculture. Descriptions of these outbreaks of Nature's usually orderly course are so common in both botanical and horticultural books that there is no need to repeat them even to the general public who scarcely more than yesterday had dinned into their ears tales of a marvelous seedless apple which led to a full discussion of the whole subject. The commercial history of the apple just referred to was so unsavory that it would seem wisest to keep discreetly silent on this subject for some time to come. But fruit-growers, even those to whom the seedless apple is a sore point, can bear the statement of a few facts.

Seedlessness is a permanent and a valuable character in many fruits. Thus, there are seedless varieties of the banana, barberry,

[1] Theophrastus. De caus. pi. Lib. 3, c. 23.

[2] Pliny. Lib. XV, c. 15.

breadfruit, date, persimmon, fig, grape, lemon, medlar, mulberry, opuntia, orange, peach, pear, pineapple, pistacio, plum, pomegranate, and strawberry. In several of these fruits seedlessness is a commercial asset. A variety of apples without seeds, especially if it were coreless as well, attractive in appearance and of high quality, would all but revolutionize apple-growing. Here, then, is a chance for the plant-breeder to exercise his art.

Seedlessness in the fruits named,— many other illustrations might be given from vegetable, flower and field crops,— establishes the fact that the production of seed is not necessary for the health and vigor of plants; and in plants propagated vegetatively seeds are useless, cumbersome organs. The sooner we get rid of seeds and cores in apples the better; and given time and patience it can be done,— indeed, has been done, but the barrenness did not occur in conjunction with other desirable qualities.

What means may the fruit-grower employ to obtain seedless apples? This is the important question. We might breed seedless apples more intelligently if we knew precisely what causes the suppression of seeds. Seedless apples seem to be produced under several conditions. Thus, this fruit is reported to be usually seedless when grown in semi-tropic countries and under other conditions which cause very luxuriant growth. This antagonism between growth and seed-production is not, however, capable of being transmitted either through seeds or buds. Hybridization is a well-known agent in diminishing the number, size and fertility of seeds in plants when the cross is a violent one or between distinct species. But crossing varieties of apples, so far as the experience at this Station goes or the scant and fragmentary accounts in literature show, has little effect on seed-bearing. Seedless apples and pears have been produced by Ewert, a German, at will, by protecting the stigmas from pollen. But none nor all of these causes acting alone or in combination for a short period nor accumulatively over a long one seem to account satisfactorily for seedless fruits.

Seedless varieties usually bear abnormal flowers, these either lacking sexual organs or petals or both. So marked are these monstrosities that the varieties are usually said to be "bloomless"

as well as "seedless." Now this suppression of floral organs and seeds comes from seedlings, so far as we can learn from the more or less obscure histories of a score of seedless apples, from normal parents. In no case is there anything to lead to the suspicion that the loss of the capacity to produce seeds is the accumulated retrogression of several generations. In other words, seedless varieties of apples, and of such other fruits as opportunity has offered to study, appear to be sports or mutations. The Navel orange, the Stoneless plum, the Lombardy poplar, Sultana, Zante and several other grapes are well known varieties of species which commonly bear seeds. All historical evidence shows that these probably came into being as mutations.

Curiously enough no one seems ever to have tried planting the occasional seed to be found in seedless fruits, thus to ascertain whether the abnormality is passed from parent to offspring. If true mutations, such should be the case. Seedlings of seedless apples and a seedless pear, though crossed with other varieties, should fruit at Geneva this year or next and in time we may know more about the inheritance of seedlessness. Meanwhile, apple-growers everywhere should be on the lookout for seedless sorts and when found, even though other characters are such as to make them worthless, they should be preserved as possible starting points for new and better seedless kinds if hybridization be possible or if they can be made to produce a few selfed seeds.

A character so markedly abnormal as seedlessness might be expected to carry with it correlations in fruit or plant. In the observation of seedlessness at this Station the search for correlations has been fascinating, indeed irresistible, but the rewards have been no greater than in similar searches for this interesting phenomenon — correlation. A few dubious statements can be set down from the hasty work done with the apples on our grounds. The abortion or malformation of one or several of the floral organs that accompanies most of the seedless apples has been mentioned. Such abnormalities are, of course, cause of the effect more than correlations with seedlessness. The apples in all seedless varieties that

we have seen are below medium in size, showing a tendency to decrease in size with seedlessness. The varieties are usually productive — at least there is nothing to indicate incompatibility between seedlessness and fruitfulness. The flavor of all of these seedless apples is below the mark, probably through accident. The cores are usually small and partly or, in a few cases, wholly absent.

These brief statements serve to introduce a list of growers of different varieties of seedless apples reported in the United States during the past twenty years, with the place of origin. There are probably a few duplications in this list and it is certain that it is not complete. Many of the men named do not respond to letters, but an investigation would probably lead to the discovery that the seedless variety is still in existence in the locality. Trees from those marked with an asterisk are under cultivation on our grounds. We shall be glad to have cions or buds of other seedless sorts with the hope that from some existing seedless apple may be bred a worthy variety without seeds.

Atlas J. Allen, Waynesville, N. C.,
J. H. Bailey, Linn, W. Va.,
H. E. Bemis, Green Cove Springs, Fla.,
Miss Portia E. Binkerd, West Monterey, Pa.,
T. J. F. Browns, Sands, N. C.,
Benj. Buckman, Farmingdale, Ill.,
W. M. Burns, Grantville, W. Va.,
Thos. P. Butcher, Parkersburg, W. Va.,
C. O. Crosby, Coquille, Ore.,
Samuel Donaldson, Kittanning, Pa.,
F. B. Doran, Clarkson, Va.,
*Fairbury Nurseries, Fairbury, Neb.,
James Flury, Lindsey, Ont.,
H. H. Farthing, Hattie, N. C.,
E. O. Goff, Spencer, W. Va.,
E. S. Granel, Cleveland, Ohio,
W. H. Hart, Arlington, N. Y.,
C. F. Hodge, Worcester, Mass.,
C. S. Hunter, Seven Mile, Ohio,
Dr. Nannestad B. Jorn, Brooklyn, N. Y.,
W. T. Macoun, Ottawa, Canada,
W. S. Miller, Martinsburg, W. Va.,
*D. J. Miller, Millersburg, Ohio,
Geo. E. Murrell, Fontella, Va.,
Geo. Peters & Co., Troy, Ohio,
A. J. Reaser, Roncerverte, W. Va.,
Mrs. J. P. Reichert, Manorville, Pa.,
G. W. Robinette, Flag Pond, Va.,
E. L. Smith, Hood River, Ore.,
*J. F. Spencer, Grand Junction, Colo.,
G. W. Stewart, Newport, Me.,
*Dept. No. 24476 — Van Hoy Seedless,
*Dept. No. 24626 — No Blow Seedless,
*Dept. No. 40830 — Bloomless & Seedless,
*Dept. No. 40833 — Parker Seedless,
U. S. D. A.,
J. Van Lindley, Pomona, N. C.,
Chas. L. Wayland, Crozet, Va.,
*Chas. Waters, Bingen, Wash.,
*Edward Wellington, Waltham, Mass.

CATALOG OF APPLES.

This catalog contains 804 apples. The majority of these, 698 in all, were described in the Apples of New York [1] and in Bulletin 275 [2] from this Station. Nearly all of the varieties found in the three publications are, or have been, grown in the Station orchard. Some changes have been made in the discussion of the old varieties and the Station records of new varieties have been supplemented by information from originators and introducers. To enable fruit-growers to dig a little below the surface in using the catalog a few explanatory notes are necessary.

Place of origin.— The first column in the catalog gives the place of origin of the varieties. The origin of a fruit is well worth knowing for its practical value, as it often helps very materially in determining whether a variety should be planted in a region. Thus, it may be assumed that the Russian sorts grown in America are particularly well suited to northern regions; that those from south of the Mason and Dixon line are true southerners as those from the north are northerners; it may even be assumed that an apple originating in New York will succeed there better than in any adjoining State, as it must have been well fitted to its habitat to have succeeded well enough to get out of the limbo of unnamed seedlings. To this statement there are several notable exceptions, some sorts thriving within the State that according to theory ought to fail forthwith.

Bearing age.— The second column tells the number of years it took varieties to come into bearing in the Station orchard. The ages of bearing are not very trustworthy; for in most cases there have been but two trees and the varieties were not planted the same year. And, again, a decade or more ago when trees were headed high and pruned much, it took them longer to come into bearing than nowadays when we head low and prune little. Yet the ages given are suggestive and seem to the authors worth printing.

[1] N. Y. Agr. Exp. Sta. "Apples of New York."
[2] N. Y. Agr. Exp. Sta. Bull. 275.

Form.—The third column gives the form of fruit in varieties. An especial attempt has been made to make as accurate a pen picture of the form of apples as can be made in an abbreviated description under the belief that form as compared with size and color in giving apples handsome appearance is usually underrated. The mould in which it is cast very often determines the attractiveness of an apple to the prospective consumer. To use this catalog intelligently, then, the reader must have in his mind the exact form for which each abbreviation in the third column stands.

Size.— In the fourth column the size of varieties is indicated. In the eye of the average person, size is esteemed about the highest quality a fruit may possess. Large size is distinctly meritorious in culinary apples, saving waste in paring and coring, but for dessert the medium sized fruit should be preferred — mere size is about the least needed quality. This distinction between culinary and dessert apples should be kept in mind in using this catalog. It should be remembered, too, that quality is in no way correlated with size in a variety though it may be in individuals, as when undue size has been brought about by irrigation, rich soil, or girdling, in all of which cases large size is accompanied by low quality.

Color.— The abbreviations in column five give as accurately as possible the color of varieties. This character is of utmost importance in identifying varieties but does not, as many appear to think, indicate in the least the quality of the fruit — color and quality are not correlated. Connoisseurs find yellow, green or russet apples quite as high in quality as the red sorts. The average person, personification of the consumer, makes a fetish of red, the more brilliant the better, and this must be taken in account in choosing color, paradoxical though it is that while apples are grown to eat we grow that which is scarcely fit to eat provided only that it have brilliant color. In studying this character, keep in mind that color is much influenced by environment, especially by soil and sunshine.

Color of flesh.— This character is of very great importance in identifying some varieties. There are, as column six shows, but few colors; but these are distinctive, as permanent as almost any other character of the apple and are plainly indicated by the abbreviations. Color of flesh, as with color of skin, gives no clue to quality in varieties.

Flavor.—Under flavor, as described in the seventh column, the degree of sweetness and acidity of a variety is described by terms which need no defining. Flavor is a concrete and definite part of quality and should be noted, therefore, in connection with the descriptions of quality as given in the next column.

Quality.— That undefined thing known as quality is set forth in the eighth column. What is quality? The word is constantly rolled under the tongue by growers and consumers but like good cheer in the fable is fish to one, flesh to another and fowl to a third. As used in this catalog we mean, in brief, that combination of flavor, aroma, juiciness and tender flesh which makes an apple agreeable to the palate. Beside these there is a wholly undefinable thing in the quality of a fruit which in human beings would be called personality. Some apples, as the McIntosh, Spy, Spitzenburg, Newtown Pippin or Grimes — and all sorts of high quality — have this individuality which separates them from commonplace sorts. It is quite impossible for one person to convey to another in a column of abbreviations the flavor, aroma, juiciness, tenderness and "personality" of a variety of apples. All that the authors can do is to express the degree of goodness of quality as it appeals to their tastes by such simple words as best, good, fair, poor, with the adverb "very" now and then used to still further separate the degree.

Use.—In the ninth column the use is denominated. The use has been arbitrarily determined by the describers. If an apple is choicely good, it is put down as a "dessert" sort; if not especially pleasing to the taste it is roughly lumped as a "kitchen" apple. This is not fair to the kitchen but this is the method of separation everywhere in vogue. Some sorts are marked for both

dessert and kitchen; most of these have been tried or prepared in one or more ways for the table. It may usually be assumed, but not always, that a good dessert apple is a good kitchen apple. A dessert apple may always be considered valuable for home use. Desirability for cider or for local, general or foreign markets is designated only under "remarks."

Season.—The tenth column shows the season of varieties. The data regarding keeping quality has been taken from apples in common storage and covers periods of from one to ten seasons. The amount of fruit stored ranges from a peck to a bushel, the aim being to put in storage each year a bushel of each variety for the long-keeping test. The months given are those in which the apples become edible and in which they pass entirely out of season — a very wide range for which allowance must be made.

Apple regions of New York.—The next nine columns list apples for the nine pomological regions into which New York may be divided. The lists are founded upon the reputed behavior of the varieties in the regions as to size, color, keeping quality, and flavor of fruit; and as to longevity, vigor, health and productiveness of tree. In some cases varieties have been put in the list for a region because of its reputation as to the characters named in an adjoining or similar region.

The pomological regions of New York have been set off somewhat in accordance with the physical geography of the State but more particularly with reference to the distribution of its wild and domesticated plants. Not much attention could be paid to soils, since through glacial action these have been carried to and fro so that there are few large areas in the State in which there is any great degree of uniformity. It must not be thought, however, that soils are not important determinants of profitable fruitgrowing; to the contrary, they set the seal of profit of kind and of variety of fruit and must ever be considered.

The following are the nine pomological regions of New York:

Long Island.— This district is composed of the sandy lowland of Long Island. It is a low plain covered with a thick deposit

in which sand predominates. The varieties of fruits cultivated here, and especially of the apple, are not very distinctive. The limits of the northern and of southern sorts meet, giving a great number of varieties for the district and making it difficult to form a definite list.

Hudson Valley.— This region lies on both sides of the Hudson from Long Island to the valley of Lake George in Warren and Washington counties. The varied topography and the several geological formations giving different soils make it possible, and probably desirable, to subdivide this district into several secondary regions. But the district is considered as one in the horticultural literature of the State; our data have been collected for the united district; and since it would complicate the work of making out lists very greatly, subdivisions have not been made.

The complexities of climate, topography and soil, however, must be kept in mind in using the table of adaptations. Where the region touches the seashore, and for several miles inland, the list prepared for Long Island will be applicable. In the northern part of the region and the high altitudes the varieties recommended for the Champlain valley should all thrive.

St. Lawrence and Champlain valleys.— This region is the high and rolling land tributary to Lake Champlain and the St. Lawrence river and such parts of the Adirondacks as are adapted to apple-growing. Three divisions could well be made of this district; the two valleys could be kept distinct, each to include only the area of lower land adjacent to the water; and the third to be the high uplands which run back into the Adirondacks. We have no data, however, which indicate that lists for the three districts would differ greatly and we have therefore included them as one. It is hardly necessary to say that only the hardiest varieties would thrive in the high uplands and that in favored locations near the water some of the more southern and more tender sorts could be grown.

Mohawk Valley.—The valley of the Mohawk from Oneida Lake to the valley of the Hudson is a district of indistinct boundaries

ABBREVIATIONS.— *Size.*— l, large; m, medium; s, small; v, very. *Form.*— a, angular; c, conic l, light; r, red; ru, russet; s, striped; w, white; y, yellow. *Flavor.*— a, acid; b, brisk; m, mild; s, swee *Starring.*— *, recommended; **, well recommended; +, worthy of trial.

No.	VARIETY.	Origin.	Bearing age.	Form.	Size.	Color of skin.	Color of flesh.	Flavor.	Quality.	Use.	Season.
1	Adirondack	N. Y.		r c	m	y r s	y w	m sa	g	k	Oct., Jan.
2	Admirable	Eng.		r o c	m	g y	y w	m sa	g-vg	d	Oct., Jan.
3	Akin	Ill.	8 yrs.	r o i	m	y r s	y	b sa	g	d	Jan., June
4	Alabama	Unk.		r i	m	y g r s	y	sa	f	k	Oct.
5	Albion	Unk.		r ob	l—vl	y g	y	m sa	g	d	Oct., Jan.
6	Alden	Wis.		r c	m—l	y r	y	sa	f	d	Aug., Sept.
7	Alexander	Rus.		r o c	vl	y r s	y w	m sa	f—g	k	Sept., Nov.
8	(II) Allington	Eng.	4 yrs.	r i	m—l	g y r s c	y	b sa	g	d k	Nov., Jan.
9	Allison	Tenn.		r o c a	m	g r s	g y	m sa	f	k	Mar., May
10	Alice	Vt.		r ob c	m	g y b	y w	s	g	k	Aug., Sept.
11	Amassia	Eu.		r c	m	y g r s	w	m sa	g—vg	d	Dec., Apr.
12	American Best	Unk.		r c	m	y b	w	m sa	g	k	Aug.
13	American Codling	Minn.?		r o c	m	g y b	y w	sa	g	k	Sept., Oct.
14	American Pippin	Unk.		o	m	g r s	y w	m sa	p—g	k	May
15	Amos	Unk.		r o	m—s	y b	y w	b sa	f—g	k	Nov., Mar.
16	Amsterdam	N. Y.		r o	m	g y r s	w	s	g	d	Oct., Nov.
17	Ananarnoe	Rus.		r o	m	y r s	w	sa	g	k	Sept.
18	Andrews Winter	Unk.		r c	s	y g r s	w	m sa	f—g	d	Mar., June
19	Angers	Unk.		r c	l	g y r	y	b sa	g	k	Nov., Dec.
20	Anisim	Rus.		r c	m—s	g y r	g w	m sa	g	d	Oct., Dec.
21	Anis Rose	Rus.		r o	m—l	y w r s	w	sa	g	k	Aug., Sept.
22	Antonovka	Rus.		r	l	y	y	b sa	g	k	Oct.
23	Aport Orient	Rus.		r ob c	l	y r s	y w	m sa	f	k	Aug.
24	Arabka	Rus.	6 yrs.	r o	l—vl	g y b d	w	b sa	f	k	Nov., Dec.
25	Arctic	N. Y.		r o c	l—m	y r s	y	m sa	g	k	Oct., Feb.
26	Arkansas	Ark.	8 yrs.	r c	l—m	g y r s	g w	sa	g	k	Dec., May
27	Arkansas Beauty	Ark.	8 yrs.	r c	m—l	g y r s	y w	m sa	g	k	Jan., Feb.
28	Arkansas Black	Ark.		r	m	y d r	y	b sa	g	k	Dec., Apr.
29	Armorel	Eu.	4 yrs.	o	s	y ru	y	b sa	g	k	Jan., Mar.
30	Arnold	Can.		o	m	y w b	y	m sa	v g	d	Nov., Mar.
31	Arthur	Ia.		ob	m—s	y g r s	y	sa	f—g	k	Oct., Jan.
32	Aucuba	Fr.		r c	m	y r s	y w	b sa	g—vg	k	Oct., Jan.
33	August	Minn.		r o c	m—s	g y r s	y	m sa	f	k	Aug., Sept.
34	Augustine	Va.?		r ob c	m—l	y r s	....	s	g	d	Aug.
35	Autumn Bough	Am.		ob c	l	y	w	s	vg	d k	Aug., Sept.
36	Autumn Streaked	Rus.		r o	l	y r s	y	sa	g	k	Sept.
37	Autumn Swaar	Unk.		r o c	m—l	g y	y	m sa	vg	d k	Sept.
38	Autumn Sweet Swaar	Unk.		r o	l	y	y w	v s	vg—b	d	Sept., Oct.
39	Avery	Unk.		r o c	l	g y r s c	y	b sa	f	k	Sept., Oct.
40	Axident	Kan.		r c	l	y d r c	y	sa	g	d k	Jan., Mar.
41	Babbitt	Ill.	11 yrs.	r o	l	y r s	....	b sa	g	k	Nov., Feb.
42	Bailey Spice	N. Y.		r c	m	y	w	sa	g—vg	d	Sept., Oct.
43	Bailey *Sweet*	N. Y.	8 yrs.	r c	l—m	y r s	y	s	vg	d k	Oct., Jan.
44	Baker	Conn.		r c	m—l	y g r s	y	m sa	g	k	Oct., Feb.
45	Baker Sweet	Conn.	10 yrs.	r	m	y	y	s	g—vg	d	Nov., Dec.
46	Baldwin	Mass.	8 yrs.	r c	l	y r s	y	b sa	g—vg	d k	Nov., Mar.
47	Banana Sweet	N. J.		r c	l	g y b	w	s	g	d k	Jan., Mar.
48	Banks	A bud sport of Gravenstein, much higher colored than that variety.									
49	Baptist	Ky.		o r	m—s	g y r s	y	m sa	f—g	d	Jan., June
50	Barbel	Rus.		o c	m—l	y r	y	sa	g	d	Oct., Feb.
51	Barcroft	Pa.		r o	s	g y b	....	m sa	g	k	Dec.
52	Barnes Choice	Unk.		r o	s—m	g y b	w	b sa	g	k	Sept.
53	Barringer	N. Y.		r c	l—m	r s	y w	m sa	vg	d	Dec., Mar.
54	Barry	N. Y.		r o	m—l	y b	y w	b sa	g	k	Nov., Dec.
55	Barton	N. Y.		r o	l	y r s c	y w	m sa	f	d	Sept., Oct.
56	Battyani	Eu.		r o c	l	g y d b	y w	b sa	g	k	Dec., Jan.
57	Batullen	Eu.		r c	m	y b	y	sa	vg	d	Nov., Mar.
58	Baxter	Can.		r c	l—vl	y r s	y	m sa	f—g	k	Nov., Jan.
59	Bayard	Unk.		o c	l	y d r c	y w	sa	f	k	Nov., Dec.

i, irregular; o, oblate; ob, oblong; ov, ovate; r, roundish. *Color.*— b, blush; c, carmine; d, dark; g, green;
s, subacid. *Quality.*— b, best; g, good; f, fair; p, poor; v, very. *Use.*— d, dessert; k, kitchen.

No.	Long Island.	Hudson Valley.	St. Lawrence and Champlain Vl'ys.	Mohawk Valley.	Eastern Plateau.	Central Lakes.	Ontario Shore.	Erie Shore.	Western Plateau.	REMARKS.
1	...	...	...	...	...	...	...	...	...	Promising early winter apple for northern New York.
2	...	...	...	...	...	...	...	...	...	Not recommended for New York.
3	+	+	...	...	...	+	...	...	...	A beautiful apple of good quality.
4	...	...	...	...	...	...	...	...	...	Not recommended.
5	...	...	...	...	...	...	...	...	...	Surpassed by others of its season.
6	...	...	...	...	...	...	...	...	...	Not valuable.
7	*	*	**	**	...	**	**	**	*	Tree characters good. Fruit large and beautiful but of only fair quality. A commercial variety.
8	...	...	...	...	...	...	...	...	...	An English variety not valuable in New York.
9	...	...	...	...	...	...	...	...	...	A Southern apple not promising in New York.
10	...	...	...	...	...	...	...	...	...	Discarded at this Station.
11	...	...	...	...	...	...	...	...	...	A European variety of no value.
12	...	...	...	...	...	...	...	...	...	Of no value.
13	...	...	...	...	...	...	...	...	...	Of no value.
14	...	...	...	...	...	...	...	...	...	Probably two varieties under this name. Neither valuable.
15	...	...	...	...	...	...	...	...	...	A Southern variety worthless in New York.
16	...	...	...	...	...	...	...	...	...	Not valuable.
17	...	...	...	...	...	...	...	...	...	Not desirable.
18	...	...	...	...	...	...	...	...	...	Worthless.
19	...	...	...	...	...	...	...	...	...	Of no value.
20	...	...	...	...	...	...	...	...	...	May be of value where superior hardiness is a prime requisite.
21	+	+	+	+	+	+	+	+	+	Worthy of testing.
22	...	...	...	...	...	...	...	...	...	Of no value.
23	...	...	...	...	...	...	...	...	...	Not recommended for New York.
24	...	...	...	...	...	...	...	...	...	Worthless in New York.
25	...	...	*	*	...	...	...	...	...	Worthy of trial in northern New York.
26	...	...	...	...	...	...	...	...	...	Valuable in the South but not in New York.
27	...	...	...	...	...	...	...	...	...	Not valuable.
28	...	...	...	...	...	...	...	...	...	Not valuable in New York.
29	...	...	...	...	...	...	...	...	...	Not recommended.
30	...	...	...	...	...	...	...	...	...	A Northern Spy seedling. Too tender for market.
31	...	...	...	...	...	...	...	...	...	A Northwestern variety nearly as hardy as Oldenburg.
32	...	...	...	...	...	...	...	...	...	A French apple of doubtful value here.
33	...	...	...	...	...	...	...	...	...	Not recommended.
34	...	...	...	...	...	...	...	...	...	Discarded.
35	*	*	...	*	*	*	*	*	*	Ranks among our best sweet apples.
36	...	...	...	...	...	...	...	...	...	Somewhat like the Oldenburg but surpassed by that variety.
37	...	...	...	...	...	...	...	...	...	Hardy and vigorous but lacks productiveness.
38	...	...	...	...	...	...	...	...	...	Crowded out by better sorts of its season.
39	...	...	...	...	...	...	...	...	...	Worthless.
40	...	...	...	...	...	...	...	...	...	Hardly worth planting.
41	...	...	...	...	...	...	...	...	...	A shy bearer.
42	...	...	...	...	...	...	...	...	...	Now nearly obsolete.
43	...	...	...	...	...	...	...	...	...	Fruit of fine appearance. Tree characters undesirable.
44	...	...	...	...	...	...	...	...	...	An old variety superseded by the Baldwin. Nearly obsolete.
45	...	...	...	...	...	...	...	...	...	An old variety, productive. No commercial importance.
46	**	**	**	**	**	**	**	**	**	Standard winter apple of New York.
47	...	...	...	...	...	...	...	...	...	Little known in New York.
48	+	+	+	+	+	+	+	+	+	
49	...	...	...	...	...	...	...	...	...	Fruit very inferior.
50	...	...	...	...	...	...	...	...	...	A hardy tree bearing rather inferior fruit.
51	...	...	...	...	...	...	...	...	...	Of no value.
52	...	...	...	...	...	...	...	...	...	Not recommended.
53	...	...	...	...	...	...	...	...	...	A local apple known only in Columbia county.
54	...	...	...	...	...	...	...	...	...	Not valuable.
55	...	...	...	...	...	...	...	...	...	Of no value.
56	...	...	...	...	...	...	...	...	...	Surpassed by better varieties.
57	...	...	...	...	...	...	...	...	...	Unproductive at this Station.
58	...	...	**	*	...	...	...	...	...	Valuable in northern New York.
59	...	...	...	...	...	...	...	...	...	Not recommended.

ABBREVIATIONS.— *Size.*— l, large; m, medium; s, small; v, very. *Form.*— a, angular; c, conical; l, light; r, red; ru, russet; s, striped; w, white; y, yellow. *Flavor.*— a, acid; b, brisk; m, mild; s, sweet; *Starring.*— *, recommended; **, well recommended; +, worthy of trial.

No.	VARIETY.	Origin.	Bearing age.	Form.	Size.	Color of skin.	Color of flesh.	Flavor.	Quality.	Use.	Season.
60	Beach	Ark	7 yrs.	r	m	y r s	y w	sa	f—g	k	Feb., May
61	Beautiful Arcad	Rus		ob	m	y r s		s	vg	d	Aug., Sept.
62	Beauty of Bath	Eng.?	7 yrs.	o	m	y r s c	y w	sa	g	d	Aug.
63	Beauty of Kent	Eng		r	l	g y r s	y	sa	g	k	Oct., Nov.
64	Belborodooskoe	Rus	8 yrs.	r	m—l	g y	w	m sa	g	k	Aug.
65	Belle et Bonne	Eu		r o	l—vl	y g	y	m sa	g	k	Nov., Jan.
66	Belmont	Pa		r ob c	m—l	y b	y	m sa	vg	k d	Oct., Feb.
67	Ben Davis	Ky	4 yrs.	r ob c	m—l	y r s	w y	m sa	g	k	Jan., June
68	Ben Hur	Ind		r ob c	l	g y r s c	y w	m sa	f—g	k	Dec., Feb.
69	Benninger	Pa	6 yrs.	r o	m	y r s	y	m sa	g	d	Aug., Sept.
70	Benoni	Mass		r c	m	y r s	y	sa	g—vg	d	Aug., Sept.
71	Bentley	Va. ?		r ob c	m	y r s	w	s	g	k	Dec., May
72	Bergen	N. Y		r	m	g w r s	w	m sa	g	k d	Jan., Feb.
73	Bess Pool	Eng		r c	m	y r s	w	b sa	g	d k	Nov., Mar.
74	Bethel	Vt		r c	l	y r s	w	m sa	f—g	k d	Nov., Mar.
75	Bethlehemite	O. ?		r o c	m	y g r s	w	m sa	g—vg	d k	Nov., Mar.
76	Bietigheimer	Ger	8 yrs.	r o c	vl	y r s	w	sa	f—g	k	Sept., Oct.
77	Billy Bond	Eu. ?		r ob c	l—m	y r s	y	sa	g	k	Nov., Jan.
78	Birth	Rus		r c	m—l	g y b	w	m sa	f	k	Sept.
79	Bismarck	N. Z	7 yrs.	r o c	l—vl	y r s	w	sa	f—g	k	Oct., Dec.
80	Black Annette	N. E. ?		r o	m	g d r s	w	m sa	vg	d	Dec., Apr.
81	Black Ben Davis	Ark	5 yrs.	r c	m—l	y d r	w	m sa	g	k	Jan., Apr.
82	Black Gilliflower	Am	12 yrs.	ob c	m—l	y g d r	w	m sa	g	d k	Oct., Feb.
83	Blenheim	Eng		r o c	l—m	y r	y w	m sa	g—vg	d k	Oct., Dec.
84	Blood Red	Minn		o	m	y r	y	m sa	g	k	Sept., Oct.
85	Bloomfield	Md		r o c	l—m	y g r	y	sa	f	k	Oct., Nov.
86	Blue Pearmain	Unk		r	l—m	y d r s	y	m sa	g	d k	Oct., Mar.
87	Blushed Calville	Rus		r c	m—l	y g b r	w	sa	f—g	k	Aug.
88	Blushing Bride	Unk		r o c	m—s	y d r	y g	m sa	f	k	Nov., Dec.
89	Bogdanoff Glass	Rus	8 yrs.	r c	l	g y b	g w	b sa	f—g	k	Nov., Feb.
90	Boiken	Eu	5 yrз.	o c a	m—vl	y b	w	b sa	g	k	Nov., Mar.
91	Bonum	N. C		o	m—l	y r s	y w	m sa	v g	d k	Nov., Dec.
92	Borovinka	Rus	7 yrs.	r	m—l	y r s	y	sa	g	k	Aug., Sept.
93	Borsdorf	Ger		o	m—s	y b	w	m sa	f	k	Nov., Feb.
94	Boskoop	Eu		o	l	y g r	y	b sa	g	k	Sept., Nov.
95	Bostick	Unk	9 yrs.	r o c	l	y r s c	y w	m sa	f	k	Nov., Dec.
96	Boston Russet	N. Y		r c	m	y g ru	y	m sa	f—g	k	Jan., Apr.
97	Bottle Greening	Vt		r o c	m—l	g y b	y w	sa	g—vg	d k	Oct., Mar.
98	Boy's Delight	Can		r	m	g y r s	w	m sa	g	d	Oct., Jan.
99	Brackett	Am		o	m	g b d r	y' w	sa	p	k	Jan., Apr.
100	Bramley	Eu	6 yrs.	r o	l	y g r s c	w	b sa	g	k	Nov., Dec.
101	Breskovka	Rus	6 yrs.	r	m	y	w	sa	f—g	k	Aug., Sept.
102	Brown	Unk		r o	m—l	y g b	y w	sa	g	k	Sept.
103	Brownlees	Eng		o	m—l	y ru	y w	b sa	vg	d k	Oct., Jan.
104	Brown Sweet	N. Y		ob c	l	g y b	y	s	g—vg	d k	Sept., Jan.
105	Buckingham	Am		o	l	y g r s	y	m sa	f—g	k	Nov., Apr.
106	Buda	Unk		r o c	l	g y r s c	y w	sa	f—g	k	Sept.
107	Bullock	N. J		r c	m	y g ru	y	m sa	vg—b	d	Oct., Jan.
108	Bunker Hill	N. Y		r c	m	y r s	w	sa	vg	d	Oct.
109	Butter	Pa		r	m	y	w	s	g—vg	k	Sept., Oct.
110	Cabashea	N. Y		r o	l—vl	y g r s	y	b sa	g	k d	Sept., Oct.
111	Cagle	Unk		r o c	s	y g d r s	w y	sa	f	k	Mar., Apr.
112	Calville de Oullins	Unk		r c	m—l	y r s	y	sa	f	k	Jan., Apr.
113	Campfield	N. J		r o	m—l	y r s	w	s	g	k	Dec., May
114	Canada Baldwin	Can		r o c	m	y g r s	w	m sa	g—vg	d	Nov., Jan.
115	Canada Reinette	Unk		r o c	m—l	y b	y	sa	vg	d k	Dec., Apr.
116	Cannon *Pearmain*	Am		r o v	m—l	g y r s	y	sa	g	k	Jan., Apr.
117	Carlough	N. Y		r c	m—l	g y b	w	m sa	g	d k	Nov., Apr.

i, irregular; o, oblate; ob, oblong; ov, ovate; r, roundish. *Color.*— b, blush; c, carmine; d, dark; g, green;
a, subacid. *Quality.*— b, best; g, good; f, fair; p, poor; v, very. *Use.*— d, dessert; k, kitchen.

No.	Long Island.	Hudson Valley.	St. Lawrence and Champlain Vl'ys.	Mohawk Valley.	Eastern Plateau.	Central Lakes.	Ontario Shore.	Erie Shore.	Western Plateau.	REMARKS.
60										Not promising in this State.
61										Not recommended.
62										Might be valuable for home use.
63										Of no value.
64										Not worthy of attention in this State.
65										An old variety not equal to standard kinds.
66										Valuable for home orchards only.
67	**	**				**	**	**		Hardy, healthy, vigorous, productive. Lacks quality.
68										A Rome-Ben Davis cross. Not fully tested.
69										A pleasant flavored apple.
70										Attractive, excellent, but not large enough for market.
71										Not valuable.
72										A local variety of no importance.
73										An English variety. Poor cropper in New York.
74			**							Blue Pearmain type. Valuable in northeastern New York.
75										Newtown Spitzenburg type but surpassed by that variety.
76										Suitable for exhibition purposes only.
77										Tree characters good. Inferior in quality. Of questionable value.
78										Of no value.
79	*	*	**	*	*	*	*	*	*	Tree hardy, healthy; bears young and productive. Fruit attractive but inferior in quality.
80										Has proved very hardy in the Northwest.
81	**	**				**	**	**		Ben Davis type, and of value.
82	**	**				**	**	**		An old but still valuable variety.
83										Fruit is desirable, but tree characters are unsatisfactory.
84										Not worth planting.
85										Attractive in appearance but surpassed by other varieties.
86										An old variety now rarely planted.
87										Of no value.
88										Not recommended.
89										Hardy. May have some value in northern regions.
90		*	*	*	*	*		*	*	Widely planted as a filler, but not very desirable.
91										Not adapted to this latitude.
92										Resembles Oldenburg and surpassed by it.
93										Not recommended.
94										Quality inferior. Not worthy of planting.
95										Not adapted to this latitude.
96										Grown only about Albion, N. Y.; not valuable.
97										Tree characters good and quality high. Poor shipper.
98										A Fameuse seedling not as good as McIntosh.
99										Worthless for commercial planting.
100										Of no value. Surpassed by other varieties.
101										Not recommended.
102										Not worth planting.
103										Excellent, but lacks productiveness.
104										An Oswego county variety as yet untested elsewhere.
105										A southern apple not recommended for New York.
106										Of no value commercially.
107										High quality; small; tree characters poor.
108										Not known outside of central New York.
109										Probably not know in New York.
110										Trees unproductive, fruit unattractive.
111										Worthless.
112										Not recommended.
113										An old cider apple now practically obsolete.
114										Fameuse type. Later than Fameuse; not desirable.
115										Excelled by other varieties.
116										Valued in the South. Not adapted to New York conditions.
117										Of doubtful value in New York.

ABBREVIATIONS.— *Size.*— l, large; m, medium; s, small; v, very. *Form.*— a, angular; c, conical; l, light; r, red; ru, russet; s, striped; w, white; y, yellow. *Flavor.*— a, acid; b, brisk; m, mild; s, sweet; *Starring.*— *, recommended; **, well recommended; +, worthy of trial.

No.	VARIETY.	Origin.	Bearing age.	Form.	Size.	Color of skin.	Color of flesh.	Flavor.	Quality.	Use.	Season.
118	Carpentin	Unk		r c	s—vs	r ru	w	b sa	vg	d	Dec., Apr.
119	Cathead	Eu		r	vl	g	y w	sa	g	k	Oct., Nov.
120	Caywood	N. Y		o	m	y b	y	m sa	g	d	Jan., Apr.
121	Celestia	O		r c	m—l	g y b	y	m sa	g	d	Oct., Jan.
122	Centennial	Unk		r c i	m	y r s c	w	sa	f	k	Oct.
123	Challenger	Unk	8 yrs.	r c	m	g y r	y	s	f	k	Dec., Apr.
124	Champaign	Rus		r o	m	g y r s c	w	sa	f	k	July, Aug.
125	Champlain	Vt. ?		r c	m—l	g y b	w	sa	g—vg	k d	Aug., Oct.
126	Chandler	Am		r o	l	g y r s	g w	sa	g—vg	d	Oct., Dec.
127	Charlamoff	Rus		r ob	l—m	y r s	y	sa	g	k	Aug.
128	Charlock Reinette	Rus		o	l—m	g y r s	y	sa	g	k	Sept., Oct.
129	Cheeseboro	Unk		r c	l—vl	g ru	....	m sa	f	k	Oct., Dec.
130	Chenango	N. Y		r ob c	l—m	y r s	w	m sa	g—vg	d	Aug., Sept.
131	Chicago	Ill		o	m—l	g y r c	y	m sa	f	d	Nov., Dec.
132	Clapper	N. Y		o c	m	y r s	y	sa	g	k	Sept., Oct.
133	Clarke	N. Y		r o c	m—l	g y b	w	b sa	g—vg	d	Oct., Jan.
134	Clayton	Ind		r o c	l—m	y r s	y	m sa	g	k d	Jan., May
135	Cleopatra	Unk		ob c	l	y b	y	sa	g	d	Dec., Jan.
136	Clinton	N. Y	4 yrs.	r o c	l	g y b	y	sa	g	k	Dec., Feb.
137	Clyde	N. Y		r ob c	l	g y r s	w	sa	g—vg	d k	Oct., Dec.
138	Coffelt	Ark		r o	m	y r s	g y	m sa	g	k	Jan., May
139	Cogswell	Conn		r c	m	y r s	y	m sa	f—g	d	Dec., Mar.
140	Collamer	A red strain of Twenty Ounce.									
141	Collins	Ark	7 yrs.	r o	l—m	y r s	y	sa	f—g	k	Jan., June
142	Colton	Mass		r	m	g y b	w	m sa	f—g	k	July, Sept.
143	Colvert	Am		o c	l	g y r s	y w	sa	g	k	Oct., Jan.
144	Constantine	Rus		r c	l—vl	g y r s	g w	b sa	f—g	k	Sept., Nov.
145	Cooper	Unk		r o	l	g y r s	....	sa	g	k	Oct., Dec.
146	Cooper Market	Pa	5 yrs.	r o v	m	y g r s	w	b sa	f—g	k	Jan., June
147	Cornell	Pa.?		r o c	l—m	y r s c	w	sa	vg	d	Sept. Nov.
148	Corner	N. Y		o	m—l	y r s	y	m sa	vg	d	Nov., Dec.
149	Cortland	N. Y	6 yrs.	r o	l	y d r s c	w	sa	g	d k	Nov., Feb.
150	Counseilor Niemets	Rus		o c	m—s	y b r	y	a	f	k	Nov., Jan.
151	Count Orloff	Rus		r o c	m	g r s	w	m sa	f	k	Aug.
152	Cox Orange	Eng		r o	m	y r s	y	m sa	vg—b	d	Sept., Jan.
153	Cranberry Pippin	N. Y		r o	l	y r s	w	m sa	g	k	Oct., Feb.
154	Cream	N .Y		r o	m	y	y	s	g	d k	Sept., Oct.
155	Crimean	Rus	6 yrs.	r ob c	s	g y r s	w	sa	g	k	Sept., Oct.
156	Cross	Md		r o c	l	g w r s	w	sa	f	k	Sept., Oct.
157	Crossed No. 32	Unk		r c	m—l	g b d r	g y	sa	p	k	Dec., Jan.
158	Crotts	Kan		r ob	m—l	g r s	g y	m sa	f—g	d	Jan., May
159	Crow Egg	Ind.?		r o	m	y g	w	s	g—vg	d	Oct., Nov.
160	Crowns	Unk		r c	l	y g b	w y	b sa	g	k	Nov., Feb.
161	Czar Thorn	Rus		r c	m	g y r s	w	s	f	k	Sept.
162	Danvers *Sweet*	Mass		r c	m—l	g y b	g y	s	g—vg	d k	Nov., Apr.
163	Deacon Jones	Pa	8 yrs.	r c	l—vl	y r	y w	m sa	f—g	k	Nov., Mar.
164	Deaderick	Tenn		r c	l	g y b	y	sa	g	k	Oct., Jan.
165	De Chataigenier	Unk		o c	l	g y b	g w	m sa	f	k	Dec., Feb.
166	Delicious	Iowa	9 yrs.	r ob c	l	y r s	y	sa	g	d k	Dec., Mar.
167	Detroit Red	Am		r o c	l	y r s	w y	m sa	g—vg	d	Sept., Dec.
168	Devonshire Duke	Eng		o c	m—s	y b ry	y	sa	g—vg	d k	Dec., Apr.
169	Dickey	Ohio		o	m	y r s	y	m sa	f—g	k	Dec., Feb.
170	Dickinson	Pa		ob c	m—l	y g r s	w	sa	f—g	k	Nov., Apr.
171	Disharoon	Ga		r c	m	y g	y w	sa	g	k	Nov., Dec.
172	Doctor	Pa		o	m—l	y r s	w y	m sa	g—vg	d k	Dec., Apr.
173	Doctor Walker	Ky		r c	m	g y r s	w y	m sa	g	d k	Jan., May
174	Domine	Am	5 yrs.	o	m	g y r s	w	m sa	g—vg	d k	Nov., Mar.
175	Donn Marie	N. Z.?		o	m	g b	g y	sa	f	k	Dec., Jan.
176	Double Rose	Rus		r ob c	s	y r	y	m sa	f—g	k	Nov., Feb.

i, irregular; o, oblate; ob, oblong; ov, ovate; r, roundish. *Color.*— b, blush; c, carmine; d, dark; g, green; sa, subacid. *Quality.*— b, best; g, good; f, fair; p, poor; v, very. *Use.*— d, dessert; k, kitchen.

No.	Long Island.	Hudson Valley.	St. Lawrence and Champlain Vl'ys.	Mohawk Valley.	Eastern Plateau.	Central Lakes.	Ontario Shore.	Erie Shore.	Western Plateau.	REMARKS.
118	...	...	...	...	...	...	...	...	...	Unique but not valuable.
119	...	...	...	...	...	...	...	...	...	Obsolete in New York.
120	...	...	...	...	...	...	...	...	...	Now practically obsolete.
121	...	...	...	...	...	...	...	...	...	Not recommended.
122	...	...	...	...	...	...	...	...	...	Not recommended.
123	...	...	...	...	...	...	...	...	...	A good keeper but inferior in quality. Not recommended.
124	...	...	...	...	...	...	...	...	...	Not recommended.
125	...	...	...	...	...	...	...	...	...	Tree characters good. Suitable for the home orchard.
126	...	...	...	...	...	...	...	...	...	Probably not known in New York.
127	...	...	...	...	...	...	...	...	...	Oldenburg type, but inferior to that variety.
128	...	...	...	...	...	...	...	...	...	Of no value.
129	...	...	...	...	...	...	...	...	...	An old inferior variety fast becoming obsolete.
130	**	**	...	**	**	**	**	**	**	Attractive, good quality, easily bruised; excellent.
131	...	...	...	...	...	...	...	...	...	Not recommended as a commercial variety.
132	...	...	...	...	...	...	...	...	...	Obsolete.
133	...	...	...	...	...	...	...	...	...	Known locally only.
134	...	...	...	...	...	...	...	...	...	A western sort not known in New York.
135	...	...	...	...	...	...	...	...	...	Not recommended.
136	+	+	+	+	+	+	+	+	+	Type of Green Newtown.
137	...	...	...	...	...	...	...	...	...	But little grown in this State.
138	...	...	...	...	...	...	...	...	...	Ben Davis class. Not valuable here.
139	...	...	...	...	...	...	...	...	...	Hardy, vigorous, unproductive. Not equal to standard sorts.
140	**	**	*	*	**	**	**	**	**	
141	...	...	...	...	...	...	...	...	...	May prove valuable where Ben Davis thrives.
142	...	...	...	...	...	...	...	...	...	Of little value.
143	...	...	...	...	...	...	...	...	...	Trees hardy, healthy, productive. Inferior to Twenty Ounce.
144	*	*	**	**	*	*	*	*	*	Tree and fruit characters good. Subject to blight. A market sort desirable as a filler.
145	...	...	...	...	...	...	...	...	...	Not recommended.
146	...	...	...	...	...	...	...	...	...	Hardy, productive, lacking in size and quality. Splendid keeper.
147	+	+	+	+	+	+	+	+	+	Recommended by U. S. Department of Agriculture.
148	...	...	...	...	...	...	...	...	...	Known locally only in Orange county.
149	+	+	+	+	+	+	+	+	+	Similar to McIntosh. Promising for commercial planting.
150	...	...	...	...	...	...	...	...	...	Of no value.
151	...	...	...	...	...	...	...	...	...	Not recommended.
152	*	*	...	...	...	+	+	+	...	Desirable for the home orchard.
153	...	...	...	...	...	...	...	...	...	Suitable only for the North.
154	...	...	...	...	...	...	...	...	...	No longer cultivated.
155	...	...	...	...	...	...	...	...	...	Of no value.
156	...	...	...	...	...	...	...	...	...	Not recommended.
157	...	...	...	...	...	...	...	...	...	Worthless.
158	...	...	...	...	...	...	...	...	...	A Rambo seedling worthless in New York.
159	...	...	...	...	...	...	...	...	...	Now practically obsolete.
160	...	...	...	...	...	...	...	...	...	Fall Pippin type but not equal to that variety.
161	...	...	...	...	...	...	...	...	...	Of no value.
162	...	...	...	...	...	...	...	...	...	Vigorous, productive. Of good size and quality, poor color.
163	+	+	+	+	+	+	+	+	+	An attractive market fruit. Heavy bearer.
164	...	...	...	...	...	...	...	...	...	Tree characters good but fruit inferior.
165	...	...	...	...	...	...	...	...	...	Of no value.
166	+	+	+	+	+	+	+	+	+	Well worth testing in New York.
167	...	...	...	...	...	...	...	...	...	Of Fameuse type. Surpassed by McIntosh.
168	...	...	...	...	...	...	...	...	...	Productive, small size, drops badly, high quality.
169	...	...	...	...	...	...	...	...	...	Not worthy of cultivation.
170	...	...	...	...	...	...	...	...	...	Poor grower, very productive. Second rate quality.
171	...	...	...	...	...	...	...	...	...	A Southern apple. Not recommended.
172	...	...	...	...	...	...	...	...	...	Tree characters desirable. Fruit attractive, large, good.
173	...	...	...	...	...	...	...	...	...	Not recommended.
174	...	...	...	...	...	...	...	...	...	Wood very brittle. Productive. Fruit small.
175	...	...	...	...	...	...	...	...	...	Of no value.
176	...	...	...	...	...	...	...	...	...	Small and poor in quality.

ABBREVIATIONS.— *Size.*— l, large; m, medium; s, small; v, very. *Form.*— a, angular; c, conical; l, light; r, red; ru, russet; s, striped; w, white; y, yellow. *Flavor.*— a, acid; b, brisk; m, mild; s, sweet; *Starring.*— *, recommended; **, well recommended; +, worthy of trial.

No.	VARIETY.	Origin.	Bearing age.	Form.	Size.	Color of skin.	Color of flesh.	Flavor.	Quality.	Use.	Season.
177	Doux	Fr.?		r o	l	y r s	w	m sa	f	k	Dec., Jan.
178	Draper	Aus'lia.		o c	m	g y s r	g y	sa	f	k	Jan., Mar.
179	Du Bois	N. Y.		o	m	y r s	y	m sa	g	k	Feb., June
180	Dudley	Me.		r c	m—l	y r s	y	b sa	vg	k	Sept., Oct.
181	Dumelow	Eng.		r o	m—l	y r s	w	b sa	g	k	Nov., Mar.
182	Duncan	Eng.?		r	s—m	y r s	y	m sa	g—vg	d	Jan., May
183	Dutch Mignonne	Eu.		r o	m	y r s	y	b sa	g	d k	Jan., Apr.
184	Duzenbury	N. Y.		r ob c	m	g y r s	w y	sa	vg	d k	Feb. May
185	Dyer	Unk.		r o	m—l	g y b	w	m sa	vg—b	d	Sept., Oct.
186	Early Harvest	Am.	4 yrs.	r o	m	y	v w	sa	g—vg	d	July, Aug.
187	Early Joe	N. Y.		o c	s—m	g y r s	w	m sa	vg—b	d	Aug., Sept.
188	Early Pennock	Unk.		r	l	y r s	w	sa	f—g	k	Aug.
189	Early Ripe	Unk.		r o	m	y g	w	sa	f—g	k	Aug.
190	Early Strawberry	N. Y.		r c	m	y r s	w y	sa	vg	d	Aug.
191	Edwards Favorite	N.C.?		o	m	y g r s	w	b sa	g	k	Feb.,May
192	Egg Top	Unk.		ob c	m	y r s	w	sa	f—g	d	Nov., Dec.
193	Eicke	Neb.		r c	s—m	y r s c	y	m sa	g	k	Dec., Feb.
194	Eiser	Ger.		r c	m	y r s	y w	m sa	g	k	Jan., June
195	Elgin Pippin	Ala.		r o c	l—m	y	w y	sa	g	k	Sept., Dec.
196	Ellsworth	N. Y.		r	m	y b	w	b sa	vg—b	d	Jan., Mar.
197	English Pippin	Rus.		r o c	l	g y	w y	sa	f—g	k	Sept., Nov.
198	English Russet	Unk.		r c	m	g y ru	y w	m sa	g	d	Jan., May
199	Ensee	Unk.		r o c	l	g y r s	y	m sa	g	k	Dec., Jan.
200	Eper	Unk.		r c	s	g y r s	y w	sa	m	k	Feb., May
201	Esopus *Spitzenburg*	N. Y.	9 yrs.	r c	m—l	y r s	y	sa	vg—b	d k	Nov., Feb.
202	Evening Party	Pa.		r o	m	g y r s	y	m sa	vg—b	d	Dec., Jan.
203	Ewalt	Pa.		r c	l	y r s	w	b sa	g	k	Nov., Apr.
204	Falix	Unk.		o c	m	g y r s	w y	m sa	g	k	Nov., Apr.
205	Fallawater	Pa.	5 yrs.	r	l—vl	g y b	g w	m sa	g	k	Nov., Mar.
206	Fall Greening	N. Y.		r o	m	g y	g w	sa	g—vg	d	Dec., Feb.
207	Fall Harvey	Mass.		r	l	y	w	sa	vg	d	Oct., Dec.
208	Fall Jenneting	Conn.?		r o c	l—m	g y	w	sa	g	d k	Sept., Dec.
209	Fall Orange	Unk.		r c	l—m	g y b	w	sa	vg	d k	Sept., Nov.
210	Fall Pippin	Am.	9 yrs.	r o	l—vl	g y	w	sa	vg	d k	Sept., Jan.
211	Fall Wine	Unk.		r o	m	y r s	y	m sa	vg	d	Sept., Jan.
212	Fameuse	Unk.	5 yrs.	r o	m	y r s	w	sa	vg	d	Oct., Dec.
213	Family	Ga.		r ov	s—m	y r s	y w	b sa	g	d k	Oct., Jan.
214	Fanny	Pa.		r o c	m	y r s	w y	m sa	g—vg	d	Sept., Nov.
215	Farris	Ky.		r o	m	y r s	w	sa	g	d	Dec., Mar.
216	Ferdinand	S. C.		r c	m—l	y g b	y	sa	g—vg	d	Dec., May
217	Fishkill	N. Y.		r o	l—vl	y r	w y	m sa	f—g	k	Nov., Feb.
218	Flanders Pippin	Eng.		o	l	g y b r	w	sa	g	k	Nov., Jan.
219	Florence	Ark.		r ov	m	y w r s	y	sa	g—vg	d k	Dec., May
220	Flory	O.		r c	m	y	y	sa	g	k	Oct., Feb.
221	Flushing *Spitzenburg*	Am.		r c	m—l	y g r	w	m sa	g	k	Oct., Feb.
222	Ford	N. Y.		r c	l	y	y w	b sa	g	k	Oct., Jan.
223	Forest	N. Y.		r ob c	m	y r s	y	m sa	vg	d	Dec., Mar.
224	Fraker	Kan.		r c	m	y r s	y	m sa	g	d	Dec., Apr.
225	Franchot	N. Y.		r c	m	y r s	y	sa	g	k	Oct., Jan.
226	French Paradise	Fr.		o	m	y r	w y	m s	g	k	Aug.
227	French Pippin	Unk.		r o	l—vl	y b	y	sa	g—vg	k	Jan., May
228	Frosakers	Swed.		r o	l	y b	y w	m sa	g	k	Sept.
229	Fullerton *Sweet*	N. Y.		r c	m	y	w	s	vg	d	Oct., Nov.
230	Gano	Unk.		r c	m	y r s	y w	m sa	g	k	Dec., Apr.
231	Garden Royal	Mass.		r o	m	g y r s	y	m sa	vg	d	Aug., Sept.
232	Gardner Pearmain	N. Y.		o	m	y r s	w	s	g	d	Sept.
233	Gem	Unk.		r o c	m—l	g y r s	y	m sa	f	k	Sept.
234	Genesee Flower	N. Y.		r o	l	y g	w g	m sa	g	k	Sept., Nov.
235	Gideon	Minn.	4 yrs.	r c	l—m	y	y	sa	f—g	k	Oct.

i. irregular; o, oblate; ob, oblong; ov, ovate; r, roundish. *Color.*— b, blush; c, carmine; d, dark; g, green; s, subacid. *Quality.*— b, best; g, good; f, fair; p, poor; v, very. *Use.*— d, dessert; k, kitchen.

No.	Long Island.	Hudson Valley.	St. Lawrence and Champlain Vl'ys.	Mohawk Valley.	Eastern Plateau.	Central Lakes.	Ontario Shore.	Erie Shore.	Western Plateau.	REMARKS.
177										Not recommended.
178										Surpassed by other varieties.
179										Of Blue Pearmain type. Doubtful value.
180										Recommended where a hardy apple is wanted.
181										A standard English culinary apple, of doubtful value here.
182										Too small.
183										Tree vigorous, very productive. Fruit too small.
184										Little known outside of Putnam county where it originated.
185										One of the finest dessert apples.
186	*	*				*	*	*	*	Valuable only as an early dessert apple.
187	*	*				*	*	*	*	Of value for the home orchard only. High quality.
188										Discarded.
189										Surpassed by others of its season.
190										Planted only as a home sort.
191										Not well adapted for growing as far north as this State.
192										Nearly obsolete.
193										Not recommended.
194										Hardly worth growing.
195										Does not equal other varieties of its season.
196										Not grown outside of Columbia county.
197										Inferior to standard varieties.
198										Planted only in eastern New York.
199										Surpassed by others of its season.
200										Of no value.
201	**	**		**	**	**	**	*	*	Lacks vigor. Unproductive. Best quality. Adapted to some localities.
202										Fruit small but of high quality. Suitable for home only.
203										Tree uncertain bearer. Fruit characteristics desirable.
204										Not recommended.
205										Vigorous and productive. Fruit inferior in quality.
206										Two of this name. Neither worthy of consideration.
207										Resembles Fall Pippin; is less desirable. Very hardy.
208										Of fair quality, but easily bruised and of poor color.
209										Thrifty, hardy, good cropper. Fruit tender and poor in color.
210	**	**	*	*	**	**	**	**	**	A standard variety. Recommended.
211										Although of excellent quality, not valuable commercially.
212			**	*	*				*	Hardy, productive. Fruit scabs badly, tender, small.
213										Not desirable.
214	*	*			*	*	*	*	*	Vigorous, productive. Fruit bright red, good, small.
215										Too unattractive in color and size to be desirable.
216										May be worth planting in southeastern New York.
217			*	*	*					Worth planting in certain localities.
218										May be worthy of testing.
219										May prove valuable where Ben Davis does well.
220										Only moderately productive. Not recommended.
221										A shy bearer. Fruit drops badly. Second rate quality.
222										No longer propagated.
223										A chance seedling of doubtful value.
224										Surpassed by standard varieties.
225										Undesirable.
226										Used as a stock.
227										Not being planted in New York.
228										Without value.
229										Of no value.
230	**	**				**	**	**		Valuable where Ben Davis thrives.
231										Good dessert sort but too small for market.
232										No longer propagated.
233										Of no value.
234										Confined to western New York. Of local value only.
235										Of little value.

ABBREVIATIONS.— *Size.*— l, large; m, medium; s, small; v, very. *Form.*— a, angular; c, conical: l, light; r, red; ru, russet; s, striped; w, white; y, yellow. *Flavor.*— a, acid; b, brisk; m, mild; s, sweet; *Starring.*— *, recommended; **, well recommended; +, worthy of trial.

No.	VARIETY.	Origin.	Bearing age.	Form.	Size.	Color of skin.	Color of flesh.	Flavor.	Quality.	Use.	Season.
236	Gideon Sweet	Minn.	......	r c	m—l	y g r s	y	s	g—vg	d k	Nov., Apr.
237	Gilpin	Va.	......	r ov	m	g y b	y	m sa	g	k	Feb., June
238	Gimmersta	Swed.	......	r ov	s	g y r s c	y g	sa	p	k	Nov., Dec.
239	Ginnie	Ill.	......	o c	m—l	y r s	w	sa	g—vg	d	Sept., Nov.
240	Givens	Ark.	......	o r c	m	y g r s	y w	m sa	g	k	Jan., May
241	Gladstone	Eng.	......	r o c	m—l	g y r	y	m sa	f	k	Sept., Oct.
242	Glenloch	Tenn.	......	r o	l	y r s	y	m sa	g	k	Dec., Feb.
243	Gloria Mundi	Am.	......	r c	l—vl	g y	g y	m sa	f—g	k	Oct., Jan.
244	Golden Medal	Pa.?	......	r o	m—l	y g b	y	s	f—g	k	Dec., May
245	Golden Pearmain	N. Z.	......	r c	m—s	y b	y w	sa	f	k	Sept., Oct.
246	(I) Golden Pippin	Eng.	......	r	s	y ru	y	b sa	g—vg	d	Jan., June
247	(II) Golden Pippin	Unk.	......	r o	l—vl	g y	y	m sa	g—vg	d k	Sept., Dec.
248	(III) Golden Pippin	Mass.	......	r o	l	g y b	y	sa	g	k	Sept., Oct.
249	Golden Red	N. Y.	......	r o	m—s	y r s	y	m sa	g	d	Dec., Jan.
250	Golden Reinette	Eu.	13 yrs.	r o	s	g y r s	y	b sa	g	d	Oct., Jan.
251	Golden Reinette (Rus.)	Rus.	......	o c	m	g y	....	m sa	g	k	Sept., Dec.
252	Golden Russet	Eng.?	9 yrs.	r o c	m	g y ru	g y	sa	vg	d k	Dec., Apr.
253	Golden Sweet	Conn.?	9 yrs.	r o	m—l	y g	y	s	g—vg	d	Aug., Sept.
254	Golden White	Rus.	......	o c	m	g y r	w	s	f—g	k	Sept., Oct.
255	Golding	Am.	......	r o c	m	y	y	sa	g—vg	d k	Oct.
256	Good Peasant	Rus.	......	r o	m—l	g y r s c	y w	m sa	g	k	Sept., Oct.
257	Gracie	Minn.?	......	r o	l	y	y	m sa	g	d	Sept., Oct.
258	Graf Luxburg	Rus.	......	r o	l	g y r s c	y w	b sa	g	k	Sept., Oct.
259	Grand Duke Michel Pearmain.	Rus.	......	r o c	m—l	g y d r c	y g	sa	f	k	Nov., Dec.
260	Grandmother	Rus.	......	r ov c	m—l	g y b	w	sa	f—g	k	Nov., Jan.
261	Granite	N. H.	......	r ob	l	y r s	w	m sa	g—vg	d	Nov., Feb.
262	Gravenstein	Eu.	8 yrs.	o	l	y r s	y	sa	vg—b	d k	Sept., Nov.
263	Great Barbe	Rus.	......	o	l	y r	g w	m sa	f—g	k	Dec., Jan.
264	Great Mogul	Rus.	......	r ov	l	g y r s	w y	sa	f—g	k	Oct., Dec.
265	Green and Yellow Newtown.	N. Y.	5 yrs.	r o	m—vl	g y	g w	sa	b	d k	Feb., May
266	Green Seek-no-Further	N. Y.?	......	r c	l	y b	y	sa	vg	d	Oct., Jan.
267	Green Sweet	Am.	......	r ov	m	y g	g w	s	g	k	Dec., May
268	Greenville	O.	......	r	l—m	y b	y	m sa	g	k	Nov., Feb.
269	Greyhouse	Am.	......	o	m	g r	y	sa	f—g	k	Feb., May
270	Grimes	W. Va.	......	r ob	m—l	y	y	sa	vg—b	d k	Nov., Feb.
271	Grosh	Ohio?	......	r o	l—vl	g y r s	y w	sa	g—vg	k	Sept., Jan.
272	Grundy	Ia.	......	r ob	l	y r	w y	sa	vg	k	Sept., Oct.
273	Haas	Mo.	2 yrs.	o	m	y r s	w	b sa	f	k	Oct., Dec.
274	Hagloe	Am.?	......	r c	m—l	g y r s	w y	b sa	g	k	Aug., Sept.
275	Halt	Ark.	8 yrs.	r o c	l	g y r s c	w y	s	f	k	Nov., Jan.
276	Hanlon	O.	13 yrs.	o c	l	y r s	y w	s	f	k	Sept., Oct.
277	Hargrove	N. C.	......	r c	s—m	y v	w	m sa	g	k	Nov., Mar.
278	Hartford Rose	Conn.	......	ob c	m—l	y r c	w	m sa	g	k	Sept., Oct.
279	Harvest Redstreak	Pa.	......	o	m	y r s	w	b sa	g	k	Aug., Sept.
280	Haskell	Mass.	......	r o	l—m	g y b	y	s	vg	d	Sept., Dec.
281	Hawley	N. Y.	......	r	l—vl	g y	y	m sa	vg	d	Sept., Nov.
282	Hawthornden	Scot.	......	r	m—l	w y b	w	sa	g	k	Sept.
283	Haywood	N. C.	......	o	m	y r s c	w y	m sa	f	k	Dec., Jan.
284	Hazen	Vt.	......	r	m	y g	y	s	f—g	k	Dec., Apr.
285	Headlight	Unk.	......	r o c	m	g y r s c	y w	m sa	f	k	Nov., Jan.
286	Hedrick	W. Va.	......	o c	s	g y r	g y	sa	g	k	Nov., Jan.
287	Henniker	Eng.	......	r o	m—l	y r s	y	sa	g—vg	k d	Nov., Mar.
288	Henry Clay Summer	Unk.	......	r c	m	y d r c	w	b sa	g	k	Sept., Oct.
289	Herefordshire	Eng.	......	r o	m	g y r	y	sa	f—g	k	Oct., Jan.
290	Herkimer	N. Y.	......	r ob c	m—l	g y r s c	y	b sa	g	k	Dec., Mar.
291	Hibernal	Rus.	......	o	l	g y r s	y	b sa	g	k	Nov., Dec.
292	Hicks	N. Y.	......	r	m	y r s	w	s	vg	d	Aug.
293	Hiester	Pa.	......	r o	m	y r s	w	m sa	f—g	k	Dec., Feb.

i, irregular; o, oblate; ob, oblong; ov, ovate; r, roundish. *Color.*— b, blush; c, carmine; d, dark; g, green;
s, subacid. *Quality.*— b, best; g, good; f, fair; p, poor; v, very. *Use.*— d, dessert; k, kitchen.

No.	Long Island.	Hudson Valley.	St. Lawrence and Champlain Vl'ys.	Mohawk Valley.	Eastern Plateau.	Central Lakes.	Ontario Shore.	Erie Shore.	Western Plateau.	REMARKS.
236	...	...	...	...	...	...	...	...	...	Of no value.
237	...	...	...	...	...	...	...	...	...	An old very late keeping variety too small to be valuable.
238	...	...	...	...	...	...	...	...	...	A worthless variety.
239	...	...	...	...	...	...	...	...	...	Unworthy.
240	...	...	...	...	...	...	...	...	...	Of no value.
241	...	...	...	...	...	...	...	...	...	Not recommended.
242	...	...	...	...	...	...	...	...	...	Of no value.
243	...	...	...	...	...	...	...	...	...	Cultivated for exhibition purposes only.
244	...	...	...	...	...	...	...	...	...	May be worth trial as a late keeping sweet apple.
245	...	...	...	...	...	...	...	...	...	Of no value.
246	...	...	...	...	...	...	...	...	...	Valuable as a dessert fruit in England; little known in New York.
247	...	...	...	...	...	...	...	...	...	Hardly as good as Fall Pippin.
248	...	...	...	...	...	...	...	...	...	No longer grown in New York.
249	...	...	...	...	...	...	...	...	...	A Long Island variety now apparently obsolete.
250	...	...	...	...	...	...	...	...	...	Highly esteemed in England, but little known here.
251	...	...	...	...	...	...	...	...	...	May be of value in the north.
252	*	*	...	*	*	*	*	*	*	Hardy, vigorous, productive. Small, late, excellent.
253	...	...	...	...	...	...	...	...	...	Suitable only for home use.
254	...	...	...	...	...	...	...	...	...	Not desirable.
255	...	...	...	...	...	...	...	...	...	Seldom or never planted in New York.
256	...	...	...	...	...	...	...	...	...	Not desirable.
257	...	...	...	...	...	...	...	...	...	Of doubtful value.
258	...	...	...	...	...	...	...	...	...	Of questionable value.
259	...	...	...	...	...	...	...	...	...	Of no value.
260	...	...	...	...	...	...	...	...	...	Of little or no value.
261	...	...	...	...	...	...	...	...	...	A New England variety of little value in New York.
262	*	**	**	*	*	*	*	*	*	Bears early, productive, vigorous. Attractive, excellent.
263	...	...	...	...	...	...	...	...	...	As tested here not worthy.
264	...	...	...	...	...	...	...	...	...	Not recommended.
265	**	**	...	...	**	*	*	...	...	Standard in quality. Succeeds in certain localities only.
266	...	...	...	...	...	...	...	...	...	Now seldom found in New York.
267	...	...	...	...	...	...	...	...	...	An old variety grown only for local markets.
268	...	...	...	...	...	...	...	...	...	Suitable for general market but does not excel in quality.
269	...	...	...	...	...	...	...	...	...	An old variety, not now generally cultivated.
270	*	*	...	...	*	*	*	*	*	Beautiful and of high quality. Not always reliable.
271	...	...	...	...	...	...	...	...	...	Good, but hardly equal to Gravenstein.
272	...	...	...	...	...	...	...	...	...	Of very doubtful value.
273	...	...	...	...	...	...	...	...	...	Supplanted by better kinds.
274	...	...	...	...	...	...	...	...	...	Not worth planting.
275	...	...	...	...	...	...	...	...	...	Of no value.
276	...	...	...	...	...	...	...	...	...	Surpassed by better varieties of its season.
277	...	...	...	...	...	...	...	...	...	Not worthy of trial.
278	...	...	...	...	...	...	...	...	...	Supplanted by better kinds
279	...	...	...	...	...	...	...	...	...	Not attractive in any particular.
280	...	...	...	...	...	...	...	...	...	Desirable for the home orchard.
281	*	*	...	...	*	*	*	*	*	Handsome and delicious, but poor tree characters.
282	...	...	...	...	...	...	...	...	...	Little known. Not worthy of introduction.
283	...	...	...	...	...	...	...	...	...	Not desirable.
284	...	...	...	...	...	...	...	...	...	Not recommended.
285	...	...	...	...	...	...	...	...	...	Of no value.
286	...	...	...	...	...	...	...	...	...	Not desirable.
287	...	...	...	...	...	...	...	...	...	Not recommended.
288	...	...	...	...	...	...	...	...	...	Of doubtful value.
289	...	...	...	...	...	...	...	...	...	Does not appear to be worthy of trial in New York.
290	+	+	+	+	+	+	+	+	+	Apparently of value.
291	...	...	...	...	...	...	...	...	...	Very hardy, productive, fine for cooking.
292	...	...	...	...	...	...	...	...	...	Not recommended.
293	...	...	...	...	...	...	...	...	...	Not recommended.

ABBREVIATIONS.— *Size.*— l, large; m, medium; s, small; v, very. *Form.*— a, angular; c, conical; l, light; r, red; ru, russet; s, striped; w, white; y, yellow. *Flavor.*— a, acid; b, brisk; m, mild; s, sweet; *Starring.*— *, recommended; **, well recommended; +, worthy of trial.

No.	VARIETY.	Origin.	Bearing age.	Form.	Size.	Color of skin.	Color of flesh.	Flavor.	Quality.	Use.	Season.
294	Highland	N. Y.	......	o	s	y b	w	m sa	vg	d	Jan., Mar.
295	Hightop Sweet	Mass.	......	r o	m—s	y	y	s	vg	d	July, Aug.
296	Hilaire	Can.	......	r o	m	y r s	w	sa	g—vg	d	Nov., Jan.
297	Hilton	N. Y.	......	r	l	y g	....	sa	g	k	Sept., Oct.
298	Hoadley	Wis.	......	r o	l	g y r s	y	b sa	g	k	Sept., Nov.
299	Hog Island *Sweet*	N. Y.	......	r c	m—l	g y r s	y	s	g—vg	d	Sept., Nov.
300	Holland Pippin	Am.	......	r	l—vl	g y b	w y	b sa	g	k	Sept., Oct.
301	Holland Winter	Eng.?	......	r c	m—l	g w b	w	sa	g	k	Dec., May
302	Holmes Sweet	N. Y.	......	r c	m	y b	y	s	vg	d	Nov., Feb.
303	Hook	N. Y.?	......	r ob c	m	g y	w y	m sa	vg	d	Oct., Nov.
304	Houghton *Sweet*	Vt.	......	r o	l	y b	y w	s	g—vg	d	Sept., Oct.
305	Howard Best	Ia.?	......	o c	l	y g r s	y	sa	f—g	k	Sept., Oct.
306	Hubbardston	Mass.	9 yrs.	r c	l	y r s	y	m sa	vg—b	d k	Oct., Jan.
307	Hunterdon	Unk.	......	r o c	l	y d r s c	y	sa	p	k	Dec., Jan.
308	Hunter Pippin	N. Y.	......	r c	m	w y	w	b sa	g	k	Aug.
309	Hunt Russet	Mass.	......	o	m	y r ru	y w	sa	vg—b	d	Jan., Apr.
310	Huntsman	Mo.	......	r o	l	y g b	y	sa	g—vg	d k	Dec., Apr.
311	Hurlbut	Conn.	......	r o c	m	g y r s	w y	m sa	g—vg	d	Oct., Dec.
312	Hurne	Ark. ?	8 yrs.	r o c	m—s	g y r s	g w	m sa	p	k	Jan., Mar.
313	Hyde King	Unk.	......	r	l—vl	y g b	w y	m sa	g	k	Dec., May
314	Ingram	Mo.	......	r o	m	g y r s	y w	m sa	g—vg	d k	Feb., June
315	Iowa Beauty	Ia.	......	r o	m	g y r s	w y	sa	g	k	Sept.
316	Isham	Wis.	......	r c	m	y g r s	....	s	g—vg	d	Oct., Dec.
317	Ivanhoe	Va.	......	r o	m	g y b	....	m sa	g—vg	d	Dec., Mar.
318	Jack	N. Y. ?	......	o c	m—l	g y	y	m sa	g—vg	d	Oct., Nov.
319	Jackson	Pa.	......	r o	m	g y r s	y	m sa	g	d	Oct., Feb.
320	Jacobs Sweet	Mass.	......	r o c	l	y g b	w	s	g	d	Oct., Mar.
321	Jarvis	N. Y.	......	r o c	l	y r s	y	sa	g	k	Sept., Nov.
322	Jefferis	Pa.	4 yrs.	r o	s—m	g y r s	w y	m sa	vg	d	Sept., Jan.
323	Jefferson County	N. Y.	......	r o c	m	y r	w y	sa	g—vg	d	Oct., Nov.
324	Jenkins Seedling	Unk.	......	r c	m	y b	w g	a	p	k	Dec., Mar.
325	Jersey Black	Unk.	......	r o	m—l	y d r s	y w	m sa	g	d	Nov., Feb.
326	Jersey Sweet	Unk.	......	r c	m	y r s	w y	s	g—vg	d	Sept., Dec.
327	Jewett Red	N. H.	......	r o	m	y r s	....	m sa	g—vg	d	Oct., Feb.
328	Johnson	Wis.	......	r o	l	g y r	y	sa	f	k	Dec., Feb.
329	Johnsonite	Unk.	......	r c	l	g r s	y	sa	f	k	Jan., Apr.
330	Jonathan	N. Y.	......	r c	m	y r s	y	sa	vg—b	d k	Nov., Jan.
331	Jonathan Buler	Ill.?	......	o	l—m	y g r s	w	m sa	f—g	k	Nov., Apr.
332	Jones Seedling	Unk.	......	r o	m	g y b	g w	sa	g	k	Jan., Mar.
333	Judson	Ia.	9 yrs.	r c	vl—l	y r s	w y	b sa	f—g	k	Oct., Nov.
334	July	Rus.	......	r c	m	w y r s	y	sa	f—g	k	July, Sept.
335	Kaighn	N. J.	......	ob c	l	y r s	y	sa	g	k	Nov., Jan.
336	Kalkidon	Rus.	......	o c	l—m	g y r s	y	m sa	f—g	k	Sept., Jan.
337	Kansas Greening	Kan.	......	r c	m	g b	y	m sa	f—g	k	Jan., Apr.
338	Kansas Keeper	Kan.?	......	r c	m—l	y g r s	y	sa	f—g	k	Dec., June
339	Karabovka	Rus.	9 yrs.	o	s—m	g y r s	w	m sa	f—g	k	Aug., Sept.
340	Kecskemet	Eu.	......	o	l	g y r	y w	sa	f	k	Nov., Dec.
341	Kentish Fillbasket	Eng.	......	r o	vl	g y b	w	b sa	g	k	Oct., Dec.
342	Keswick	Eng.	3 yrs.	r c	m—l	g y b	y w	b sa	g	k	Aug., Sept.
343	King David	Ark.	......	r o c	l	y d r	y	b sa	g	k	Nov., Jan.
344	King of Pippins	Eng.	......	r o	s—m	y r s	y	b sa	g	k	Nov., Dec.
345	Kinnaird	Tenn.	6 yrs.	o c	m—l	y r	y	sa	g—vg	d k	Dec., Mar.
346	Kirkbridge	Am.	......	ob c	s—m	y w	w	sa	g—vg	d	Aug., Sept.
347	Kirkland	N. Y.	......	r c	l—m	y b	y	sa	g	k	Jan., May
348	Kittageskee	N. C.?	......	r o c	s—m	y b	y	m sa	vg	d	Dec., May
349	Lacker	Pa.	......	r o	m—l	y g r s	w	m sa	g—vg	d	Dec. May
350	Lady	Fr.	12 yrs.	o	s—vs	y b	w	sa	g—vg	d	Dec., May
351	Lady Finger	Unk.	......	r c	m	y r	g w	sa	g—vg	d	Aug.
352	Lady Sweet	N. Y.	9 yrs.	r c	l—m	y g r s	w y	s	vg—b	d k	Nov., Apr.
353	Landon	Vt.	......	r o c	m—l	y r s c	y	m sa	g—vg	d	Dec., May

i, irregular; o, oblate; ob, oblong; ov, ovate; r, roundish. *Color.*— b, blush; c, carmine; d, dark; g, green; sa, subacid. *Quality.*— b, best; g, good; f, fair; p, poor; v, very. *Use.*— d, dessert; k, kitchen.

No.	Long Island.	Hudson Valley.	St. Lawrence and Champlain Vl'ys.	Mohawk Valley.	Eastern Plateau.	Central Lakes.	Ontario Shore.	Erie Shore.	Western Plateau.	REMARKS.
294										Lady type. Suitable for localities where Lady thrives.
295										Should be dropped from cultivation.
296										Worthy of trial in Fameuse regions.
297										Passing out of cultivation.
298										May be grown where the Oldenburg thrives.
299										Little known and unworthy.
300										Resembles Fall Pippin, but poorer in quality.
301										Greening type. Keeps well.
302										A Niagara county seedling now practically obsolete.
303		*	*	*	*					Unattractive, but excellent.
304										Desirable for the local fall market.
305										Resembles Alexander.
306	**	**		*	*	**	**	*	*	Bears early, productive. Fruit handsome and good.
307										A worthless variety.
308										Of no commercial value.
309										Superseded by more valuable russet kinds.
310										Quality excellent but of doubtful value.
311										Not being planted.
312										Of no value.
313										Surpassed by Rhode Island Greening.
314										A seedling of and similar to Ralls.
315										Not desirable.
316										Not desirable.
317										Not recommended.
318										Neither tree nor fruit characters are desirable.
319										Not recommended.
320										Planted only in home orchards.
321										Not recommended.
322	*	*			*	*	*	*	*	Excellent for the home orchard.
323										Not worth planting.
324										Worthless for commercial purposes.
325										Attractive in color but valueless.
326	*	*			*	*	*	*	*	One of the best sweet apples for home use.
327			*	*						One of the best in quality of the Blue Pearmain type.
328										Surpassed by better kinds of its season.
329										Not desirable.
330	**	**		*	**	*	*	*	*	Excellent but small in New York.
331										Fruit attractive in size and color. Lacks quality.
332										Not recommended.
333										Not worthy.
334										Inferior to Tetofsky which it resembles.
335										Obsolete.
336										Very inferior.
337										Not worthy.
338										A late keeper. Succeeds better in Southern latitudes.
339										Unworthy.
340										Of no value.
341										Many worthier sorts of its season.
342										Suitable for home use only.
343	+	+	+	+	+	+	+	+	+	Appears promising as a commercial sort.
344										Surpassed by other kinds.
345										Winesap type. Not adapted to New York.
346										Not recommended.
347										Tree characters good. Fruit of good color and keeps well.
348										A late keeping dessert apple for home use.
349										Gradually passing out of cultivation.
350	*	*		*	*	*	*	*	*	A beautiful fancy apple suitable for special trade.
351										Several varieties under this name. Of no value.
352	*	**		*	*	*	*	*	*	One of the most desirable of the sweet apples.
353										Shy bearer. Good color and size.

ABBREVIATIONS.— *Size.*— l, large; m, medium; s, small; v, very. *Form.*— a, angular; c, conical; l, light; r, red; ru, russet; s, striped; w, white; y, yellow. *Flavor.*— a, acid; b, brisk; m, mild; s, sweet; *Starring.*— *, recommended; **, well recommended; +, worthy of trial.

No.	VARIETY.	Origin.	Bearing age.	Form.	Size.	Color of skin.	Color of flesh.	Flavor.	Quality.	Use.	Season.
354	Landsberg	Ger.	......	r o	m—l	g y b	y	m sa	g—vg	d	Oct., Jan.
355	Lankford	Md.	......	r o	m	g y r s	y	m sa	f—g	k	Dec., May
356	Lansingburg	O.	......	r o	m	y g r s c	g y	m sa	f—g	k	Dec., May
357	Late Strawberry	N. Y.	......	r ob c	m	y r s	y w	sa	vg	d	Sept., Dec.
358	Latham	N. Y.	......	o c	m	y r	w	m sa	g	k	Nov., Dec.
359	La Victoire	Can.	......	o c	l—m	g y r s	w	m sa	g	d	Nov., Dec.
360	Lawver	Kan.?	......	r o	m	d r	w y	b sa	f—g	k	Jan., May
361	Lead	Rus.	......	o c	m	g y r s	w	sa	f	k	Aug., Sept.
362	Lee Sweet	N. Y.?	......	r ob c	m—l	y r s	w y	s	g	k	Jan., Apr.
363	Legal Tender	Ark.?	8 yrs.	r o	l	g d r	g w	sa	g	k	Feb., May
364	Lehigh *Greening*	Pa.	......	r o c	m—l	y g	y	m sa	g	k	Jan., May
365	Lilly *of Kent*	Del.	......	r o c	l	y g	g y	sa	g	d	Jan., May
366	Limbertwig (small or red).	Unk.	......	r o c	m	y r s	y	sa	g	k	Jan., Apr.
367	Limbertwig (large or green).	Larger, greener and less attractive in color than the above, coarser, more juicy and much inferior in flavor and quality.									
368	Lincoln Pippin	Conn.	......	r o c	m	g y	w y	sa	vg	d	Oct., Dec.
369	Lindenwald	N. Y.	......	r o	m	y b	y	sa	g—vg	d	Sept.
370	Lombard	Vt.	......	r o	m—l	g y b	y w	sa	g	k	Nov., Dec.
371	Longevity	Can.	......	r c	l	g y r	y	sa	g	k	Jan., Mar.
372	Longfield	Rus.	4 yrs.	r o c	m	y b	w	sa	g	d	Sept., Oct.
373	Long Island Pearmain	Unk.	......	ob	l	y r s	....	sa	g	d	Oct., Jan.
374	(I) Long Island Russet	N. Y.	......	ob c	s	y ru	y	m sa	g	d	Oct., Feb.
375	(II) Long Island Russet	Unk.	......	r ob c	m—s	y ru	y	b sa	vg	d	Nov., Jan.
376	Long Keeper	Va.	......	r c	m—s	g r s	g w	b sa	f—g	k	Jan., Apr.
377	Long Red Pearmain	Unk.	......	o c	m—l	y r s	....	sa	g	k	Nov., Dec.
378	Long Stem	Several varieties under this name, all worthless.									
379	Long Stem of Penn	Pa.	......	r o	m	y g r s	w	b sa	g—vg	d	Nov., Feb.
380	Longworth	Ia.	......	r o c	m	w y r s	w	m sa	vg	d	Nov., Feb.
381	Lord Seedling	N. Y.	......	r ob c	m	y	y w	m sa	g—vg	d k	Sept., Oct.
382	Lord Suffield	Eng.	......	r c	l	y	w	sa	g	k	July, Sept.
383	Lou	Minn.	......	r ob c	m—l	y r s	y w	sa	f—g	k	Aug.
384	Louise	Can.	......	r c	m	g y b	w	sa	vg	d	Oct., Feb.
385	Lowell	Am.	......	r ob c	l	y	y	sa	g—vg	d k	Aug., Oct.
386	Lowland Raspberry	Rus.	......	r c	m—l	w r s	w	m sa	vg	d	Aug.
387	Lubsk Queen	Rus.	......	r	m—l	w r	w	sa	g	k	Aug., Sept.
388	Luckey	N. Y.	......	r c	m—s	g y d r c	y g	sa	f	k	Nov., Feb.
389	Lyscom	Mass.	......	r	l—v l	y g r s	w y	sa	g	k	Oct., Dec.
390	Mabie	N. Y.	......	r ob	l—m	y r s	y	s	g	k	Nov., Dec.
391	McAfee	Ky.	......	r o	m—l	y r s	y w	m sa	g—vg	k	Oct., Feb.
392	McCarty	A strain of Pumpkin Sweet. Smaller and keeps longer.									
393	McCroskey	Tenn.	......	r c	m	y d r	y	sa	f	k	Dec., Feb.
394	MacDonough	N. Y.	......	r o	m	y	....	m sa	f—g	k	Aug., Sept.
395	McIntosh	Can.	6 yrs.	r	m—l	y r s	w	m sa	vg—b	d	Oct., Dec.
396	McKinley	Ind.	9 yrs.	r o	m—l	y r s	y	sa	g	d	Dec., Jan.
397	McKinney	N. Y.	......	o	m—l	y b	w y	m sa	g	k	Jan., Apr.
398	McLellan	Conn.	......	r o c	l—m	g y r s	w	m sa	vg	d	Oct., Feb.
399	McMahon	Wis.	4 yrs.	r c	l—v l	g y w	w	b sa	f—g	k	Oct., Jan.
400	Magenta	Unk.	......	o c	l—m	y g b	y	sa	g—vg	k	Nov., Mar.
401	Magog	Vt.	......	r ob	m—l	g y r s	y	sa	g	k	Oct., Jan.
402	Magyar	Unk.	......	r c	l	y b	w y	sa	f	k	Dec., Mar.
403	Maiden Blush	N. J.	4 yrs.	o	m	y b	w	sa	g	k	Sept., Nov.
404	Maiden Favorite	N. Y.	......	r c	m	w y	w	sa	g—vg	d	Oct., Jan.
405	Mala Carle	Italy	......	o c	m	y b	w	sa	g	d	Dec., Feb.
406	Malinda	Vt.	......	r c	l—m	y b	w	m sa	f	k	Jan., Apr.
407	Mammoth	Ark.	8 yrs.	r o	l	g y	y w	s a	f	k	Dec., Mar.
408	Manchester	Unk.	......	r ob c	m—l	g y r s	y	b sa	g—vg	d	Dec., Apr.
409	Mann	N. Y.	......	r o	m—l	g y	y	sa	f—g	k	Jan., Apr.
410	Manwaring	Kan.	......	r c	m	y b	y	b sa	g	k	Oct., Jan.

i, irregular; o, oblate; ob, oblong; ov, ovate; r, roundish. *Color.*— b, blush; c, carmine; d, dark; g, green;
s, subacid. *Quality.*— b, best; g, good; f, fair; p, poor; v, very. *Use.*— d, dessert; k, kitchen.

No.	Long Island.	Hudson Valley.	St. Lawrence and Champlain Vl'ys.	Mohawk Valley.	Eastern Plateau.	Central Lakes.	Ontario Shore.	Erie Shore.	Western Plateau.	REMARKS.
354	...	...	....	...	...	...	...	...	...	Excelled by standard sorts.
355	...	...	....	...	...	...	...	...	...	Easily excelled by standard varieties.
356	...	...	....	...	...	...	...	...	...	Very late keeper but poor in quality.
357	...	...	....	...	...	...	...	...	...	One of the good dessert apples of its season.
358	...	...	....	...	...	...	...	...	...	Obsolete.
359	...	...	....	...	...	...	...	...	...	A seedling of Fameuse inferior to McIntosh.
360	...	...	....	...	...	...	...	...	...	Better adapted to southern latitudes.
361	...	...	....	...	...	...	...	...	...	Unworthy.
362	...	...	....	...	...	...	...	...	...	Grown about Geneva where it is held in high esteem.
363	...	...	....	...	...	...	...	...	...	Surpassed by other kinds.
364	...	...	....	...	...	...	...	...	...	Surpassed by other sorts of its class.
365	...	...	....	...	...	...	...	...	...	Not sufficiently tested in New York.
366	...	...	....	...	...	...	...	...	...	A southern variety not adapted to New York.
367	...	...	....	...	...	...	...	...	...	
368	...	...	....	...	...	...	...	...	...	Grown only about Syracuse.
369	...	...	....	...	...	...	...	...	...	Known only in Columbia County.
370	...	...	....	...	...	...	...	...	...	Not recommended.
371	+	+	+	+	+	+	+	+	+	Not fully tested. Attractive and appears promising.
372	...	...	....	...	...	...	...	...	...	Grown for home use and local markets.
373	...	...	....	...	...	...	...	...	...	Obsolete.
374	...	...	....	...	...	...	...	...	...	Now nearly obsolete.
375	...	...	....	...	...	...	...	...	...	Represented now only by old trees.
376	...	...	....	...	...	...	...	...	...	Not recommended.
377	...	...	....	...	...	...	...	...	...	Obsolete.
378	...	...	....	...	...	...	...	...	...	
379	...	...	....	...	...	...	...	...	...	Not recommended.
380	...	...	....	...	...	...	...	...	...	Unworthy.
381	+	+	+	+	+	+	+	+	+	New and recommended for home orchards.
382	...	...	....	...	...	...	...	...	...	So susceptible to blight as to be worthless.
383	...	...	....	...	...	...	...	...	...	Excelled by its parent, Oldenburg.
384	...	...	....	...	...	...	...	...	...	A beautiful and excellent apple for home use.
385	*	*	....	*	*	*	*	*	*	Desirable for home use and local market.
386	+	+	+	+	+	+	+	+	+	A beautiful dessert fruit.
387	...	...	....	...	...	...	...	...	...	Not recommended.
388	...	...	....	...	...	...	...	...	...	Surpassed by other kinds.
389	...	...	....	...	...	...	...	...	...	Supplanted by best sorts.
390	...	...	....	...	...	...	...	...	...	Surpassed by Victoria Sweet which it resembles.
391	...	...	....	...	...	...	...	...	...	A seedling of Lawver, not adapted to New York.
392	...	...	....	...	...	...	...	...	...	
393	...	...	....	...	...	...	...	...	...	Not recommended.
394	...	...	....	...	...	...	...	...	...	Not likely to become popular.
395	*	**	**	**	**	**	**	**	**	One of the best sorts of its season.
396	...	...	....	...	...	...	...	...	...	Not recommended.
397	...	...	....	...	...	...	...	...	...	An Ulster county seedling—not known elsewhere.
398	...	...	....	...	...	...	...	...	...	Choicely good. Adapted to fancy market.
399	...	...	....	...	...	...	...	...	...	Less desirable than standard kinds of its season.
400	...	...	....	...	...	...	...	...	...	Appears to be identical with Canada Reinette.
401	...	...	....	...	...	...	...	...	...	Not valuable enough to retain.
402	...	...	....	...	...	...	...	...	...	Not desirable.
403	*	*	....	*	*	*	*	*	*	Worthy of planting for home or market, where it succeeds.
404	...	...	....	...	...	...	...	...	...	No longer propagated.
405	...	...	....	...	...	...	...	...	...	Does not succeed as far north as New York.
406	...	...	....	...	...	...	...	...	...	Desirable only when hardiness is a prime requisite.
407	...	...	....	...	...	...	...	...	...	Not recommended.
408	...	...	....	...	...	...	...	...	...	Of Esopus *Spitzenburg* type but inferior to that variety.
409	...	...	....	...	...	...	...	...	...	A hardy, productive tree. Long keeper of fair quality.
410	...	...	....	...	...	...	...	...	...	Not recommended.

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No.	VARIETY.	Origin.	Bearing age.	Form.	Size.	Color of skin.	Color of flesh.	Flavor.	Quality.	Use.	Season.
411	Margaret	Eng.	......	r c	s—m	y r s	w	sa	g	d	July, Aug.
412	Marigold	Eng.?	......	r c	m—l	y g b	y	m sa	g	d	Nov., Apr.
413	Mason Orange	Kan.	......	ob c	m—l	y b	y	sa	g	d k	Nov., Feb.
414	Masten	N. Y.	......	r c	m	g y b	w	sa	g	k	Dec., Feb.
415	Mellott	Pa.?	......	r c	m	g y r s	y	m sa	g	k	Dec., Feb.
416	Melon	N. Y.	4 yrs.	r o c	l—m	y g r s	w	sa	vg	d	Oct., Jan.
417	Ménagère	Eu.	......	o c	l—vl	y b	w	sa	f	k	Oct., Jan.
418	Merrill	N. Y.	......	r	m	y b	y	sa	g	k	Dec., Mar.
419	Mexico	Conn.?	......	r o	l	g y d r	y w	b sa	g—vg	k d	Sept., Oct.
420	Middle	N. Y.	......	r ob c	m	g y	w	b sa	vg	d	Dec., Mar.
421	Mihalyfi	Eu.	......	r	m—s	y b	y	m sa	g	k	Jan., Mar.
422	Milam	Unk.	......	r c	s—m	y g r s	y	m sa	g	d	Nov., Jan.
423	Milden	N. H.	......	o c	l—m	y r s	w y	sa	g	d k	Nov., Jan.
424	Miller	N. Y.	......	r o c	l	y r s	y	sa	g—vg	d	Oct., Nov.
425	Milligen	Pa.	......	r o c	l	y r s	y	sa	g—vg	d	Oct., Jan.
426	Milwaukee	Wis.	......	o	l—m	y r s	y	b sa	f—g	k	Oct., Jan.
427	Minister	Mass.	......	r ob c	l—m	y g r s	y w	b sa	g—vg	d k	Nov., Feb.
428	Minkler	Pa.?	......	r o c	m	y g r s	y	m sa	f—g	k	Nov., Apr.
429	Missing Link	Unk.	......	r	l	g y r	y	m sa	f	k	Jan., Apr.
430	Missouri *Pippin*	Mo.	......	r c	m	g y r s	w	b sa	f—g	k	Oct., Jan.
431	Mock	Ark.	......	r o c	m—l	g y d r	y	sa	f	k	Jan., Mar.
432	Mon Desire	Rus.	......	r o	l	y b	w y	b sa	g	k	Nov., Dec.
433	Monmouth	N. J.	5 yrs.	r o c	l—m	y b	y	b sa	g—vg	d k	Nov., Jan.
434	Monroe *Sweet*	Unk.	......	r o c	m	y r c	y	s	g	d	Sept., Oct.
435	Montgomery	N. Y.	......	r o c	l	g w r s	w	b sa	g	k	Sept., Oct.
436	Moon	Ga.	......	r o	m	y g b	w	m sa	g	k	Nov., Apr.
437	Moore Extra	Ohio.	......	r o c	l	g y r s	y	sa	f	k	Nov., Jan.
438	Moore Sweet	Mass.	......	r o c	m—l	y g r	y	s	g	k	Nov., Apr.
439	Morgan Seedling	Am.	......	o	m	g y r	y w	m sa	f	k	Dec., Jan.
440	Mosher	N. Y.	......	o c	m	g y	y	s	g	d	Sept., Oct.
441	Mother	Mass.	9 yrs.	r c	m	y r s	y	m sa	vg—b	d	Sept., Jan.
442	Mountain Sweet	Pa.	......	r o c	m	y r s	w	s	g	d	Sept., Dec.
443	Mouse	N. Y.	......	r c	l	g y b	w	m sa	g	k	Oct., Nov.
444	Moyer	Ind.?	......	ob c	l	y b	w	m sa	g—vg	d	Dec., Apr.
445	Munroe Favorite	Aust'lia.	......	r o c	m	y	w y	a	f	k	Nov., Jan.
446	Munson	Mass.?	5 yrs.	r o	m	g y b	y	s	g—vg	d	Sept., Dec.
447	Nassau	N. Y.	......	o	m	y r s	y w	sa	g	k	Dec., Mar.
448	Nelson	Ill.	......	r ob ov	m	g y b	g y	s	g	d k	Feb., May
449	Nero	N. J.	6 yrs.	r c	m	g y r s	w	m sa	g—vg	k	Jan., Apr.
450	Newark Pippin	N. J.?	......	r ob	m—l	g y	y	sa	vg—b	d k	Nov., Feb.
451	Newman	O.	......	ob c	m—l	y g b	y	m sa	f—g	k	Dec., May
452	Newtown Spitsenburg	N. Y.	......	r o	m	y r s	y	m sa	vg—b	d	Nov., Feb.
453	New Water	Pa.?	......	o c	l—m	g y r s	w y	m sa	g	d	Oct., Feb.
454	Nickajack	N. C.	......	r c	l—m	g y r s	y	m sa	g	k	Dec., May
455	Nitchner Strawberry	Rus.	......	r c	l	y r s c	w	sa	g	k	Sept.
456	Northern Spy	N. Y.	13 yrs.	r c	l—vl	y r s	y w	sa	vg—b	d k	Dec., Feb.
457	Northern Sweet	Vt.	......	r o	m	y b	w	s	vg	d	Sept., Oct.
458	Northwestern Greening	Wis.	......	r c	m—l	y g	y	m sa	g	d k	Dec., Mar.
459	Norton Red	Unk.	......	r o c	m	y d r	y	m sa	g	d	Nov., Mar.
460	Nyari Piros	Unk.	......	r o c	l	g y r	g w	m sa	f	k	Sept.
461	Oak	N. Y.?	......	r c	m—l	y	w y	sa	g	k	Sept., Oct.
462	Oakland	Mich.	......	r o c	m—l	g y r s	w	s	g	d k	Nov., Feb.
463	Occident	Cal.	......	r o c	m	y b	w y	sa	vg	d k	Jan., May
464	Oel Austin	N. Y.	......	r c	m	y r s	y w	m sa	f—g	d k	Nov., Mar.
465	Ogdensburg	N. Y.	......	r o c	m	y b	w	m sa	vg	d	Nov., Dec.
466	Ohio Nonpareil	O.	......	r o	m—l	y r s	y w	sa	g—vg	d	Oct., Nov.
467	Ohio Pippin	O.	......	r o c	m	y b	y	m sa	g	d	Sept., Jan.
468	Okabena	Minn.	......	o	l	y r s	y	sa	vg	d	Dec.
469	Oldenburg	Rus.	2 yrs.	r o	m—l	g y r s	y w	sa	g—vg	k	Aug., Sept.
470	Old Garden	Vt.	......	r c	s—m	y b	y	s	f—g	k	Sept., Oct.

i, irregular; o, oblate; ob, oblong; ov, ovate; r, roundish. *Color.*— b, blush; c, carmine; d, dark; g, green; sa, subacid. *Quality.*— b, best; g, good; f, fair; p, poor; v, very. *Use.*— d, dessert; k, kitchen.

No.	Long Island.	Hudson Valley.	St. Lawrence and Champlain Vl'ys.	Mohawk Valley.	Eastern Plateau.	Central Lakes.	Ontario Shore.	Erie Shore.	Western Plateau.	REMARKS.
411	...	...	....	...	...	...	...	...	...	Without value.
412	...	...	....	...	...	...	...	...	...	Does not excel standard varieties of its season.
413	...	...	....	...	...	...	...	...	...	Almost identical with Yellow Bellflower.
414	...	...	....	...	...	...	...	...	...	A Dutchess county apple unknown elsewhere.
415	...	...	....	...	...	...	...	...	...	Of no value.
416	*	*	....	*	*	*	*	*	*	Choicely good for the home orchard.
417	...	...	....	...	...	...	...	...	...	Suitable only for exhibition purposes.
418	...	...	....	...	...	...	...	...	...	Unknown outside of Chenango county.
419	...	...	....	...	...	...	...	...	...	Not fully tested. Appears to have value.
420	...	...	....	...	...	...	...	...	...	Less valuable than other varieties of its season.
421	...	...	....	...	...	...	...	...	...	Of no value.
422	...	...	....	...	...	...	...	...	...	Valuable in the south only.
423	...	...	....	...	...	...	...	...	...	Succeeds only in northern and elevated regions.
424	...	...	....	...	...	...	...	...	...	Unknown outside of Orange county.
425	...	...	....	...	...	...	...	...	...	Attractive but excelled by standard sorts.
426	...	...	....	...	...	...	...	...	...	Succeeds in the northern part of the State.
427	...	...	....	...	...	...	...	...	...	It has failed to win favorable recognition in New York.
428	...	...	....	...	...	...	...	...	...	Not a promising variety.
429	...	...	....	...	...	...	...	...	...	A long keeper but does not rank high in quality. Southern.
430	...	...	....	...	...	...	...	...	...	Does not develop marketable size in New York.
431	...	...	....	...	...	...	...	...	...	Of no value.
432	...	...	....	...	...	...	...	...	...	Not fully tested in New York.
433	...	...	....	...	...	...	...	...	...	Good cropper, uncertain keeper, variable in size.
434	...	...	....	...	...	...	...	...	...	Possibly of value for the home orchard only.
435	+	+	+	+	+	+	+	+	+	Promising but not fully tested.
436	...	...	....	...	...	...	...	...	...	Unsatisfactory in this region.
437	...	...	....	...	...	...	...	...	...	Of no value.
438	...	...	....	...	...	...	...	...	...	A good keeper, good cropper, moderately attractive.
439	...	...	....	...	...	...	...	...	...	Of no value.
440	...	...	....	...	...	...	...	...	...	Without special value.
441	*	*	....	...	*	*	*	*	*	Tree characteristics poor. Appearance and quality of the best.
442	...	...	....	...	...	...	...	...	...	Of little value.
443	...	...	....	...	...	...	...	...	...	Nearly obsolete.
444	...	...	....	...	...	...	...	...	...	Similar to Yellow Bellflower. Surpassed by other sorts.
445	...	...	....	...	...	...	...	...	...	Not desirable.
446	...	...	....	...	...	...	...	...	...	Has given place to better sorts.
447	+	+	+	+	+	+	+	+	+	Of superior quality.
448	...	...	....	...	...	...	...	...	...	A late keeping sweet apple. Unattractive.
449	...	...	....	...	...	...	...	...	...	Not valuable.
450	...	...	....	...	...	...	...	...	...	An old variety now nearly obsolete in this State.
451	...	...	....	...	...	...	...	...	...	Of Yellow Bellflower group. Not recommended.
452	...	...	....	...	...	...	...	...	...	Not a good commercial sort. Excellent in quality.
453	...	...	....	...	...	...	...	...	...	Not superior to standard sorts of its season.
454	...	...	....	...	...	...	...	...	...	Not adapted to northern regions.
455	...	...	....	...	...	...	...	...	...	Not worth planting.
456	*	**	*	**	**	**	**	**	**	Tardy bearer. Vigorous. Highest quality. A standard.
457	...	...	....	...	...	...	...	...	...	Hardiness alone commends it.
458	...	...	....	...	...	...	...	...	...	Similar to Rhode Island Greening; hardier, not so good.
459	...	...	....	...	...	...	...	...	...	Appears to be of value, though not sufficiently tested.
460	...	...	....	...	...	...	...	...	...	Of no value.
461	...	...	....	...	...	...	...	...	...	Surpassed by other varieties.
462	...	...	....	...	...	...	...	...	...	Popular in Michigan. Unknown in New York.
463	...	...	....	...	...	...	...	...	...	Similar to Yellow Bellflower.
464	...	...	....	...	...	...	...	...	...	Blue Pearmain group. Adapted to cold climate.
465	...	...	....	...	...	...	...	...	...	Not now grown.
466	...	...	....	...	...	...	...	...	...	Tree characters poor; of doubtful value.
467	...	...	....	...	...	...	...	...	...	Possibly worthy of attention.
468	...	...	....	...	...	...	...	...	...	Nothing to recommend it.
469	**	**	**	**	**	**	**	**	**	Hardy, vigorous, productive, cosmopolitan.
470	...	...	....	...	...	...	...	...	...	Of no value.

ABBREVIATIONS.— *Size.*— l, large; m, medium; s, small; v, very. *Form.*— a, angular; c, conical; l, light; r, red; ru, russet; s, striped; w, white; y, yellow. *Flavor.*— a, acid; b, brisk; m, mild; s, sweet; *Starring.*— *, recommended; **, well recommended; +, worthy of trial.

No.	VARIETY.	Origin.	Bearing age.	Form.	Size.	Color of skin.	Color of flesh.	Flavor.	Quality.	Use.	Season.
471	Olga	Rus.	......	r o	l	g y r s	g w	s	g	k	Aug.
472	Olive	N. C.	......	r c	s	y r s	y	m sa	f—g	k	Nov., Feb.
473	Oliver	Ark.	......	r o	l—m	g y r s	y w	sa	g	k	Dec., Mar.
474	Olympia	See description of Baldwin.									
475	Onondaga	N. Y.	6 yrs.	r c	l	g y d r s	w y	sa	g	k	Nov., Jan.
476	Ontario	Can.	......	r o c	l	g y r s	w y	b sa	g—vg	d k	Nov., Mar.
477	Opalescent	O.?	......	r c	l—vl	y d r	y w	m sa	g—vg	d	Oct., Jan.
478	Orange	Several varieties under this name, all worthless in New York.									
479	Orange Pippin	At least two varieties of this name. Neither of value in New York.									
480	Orange Sweet	Several varieties under this name. Worthless in New York.									
481	Oranie	Swed.	......	r o	l	g y	y w	m sa	f	k	Aug.
482	Ornament	Eu.	......	r o c	m	y r s	w	m sa	g	d	Oct., Feb.
483	Ortley	N. J.	......	ob c	l—m	w y b	w	sa	vg	d k	Oct., Feb.
484	Ostrakoff	Rus.	......	r	m	y	w	b sa	f—g	k	Nov., Dec.
485	Oswego	N. Y.	6 yrs.	r c	l	g y d r s	y	b sa	vg	d	Dec., Apr.
486	Oszi Vaj	Unk.	......	r c	m	g w r	w g	m sa	f	k	Aug.
487	Otsego	N. Y.	4 yrs.	r ob c	m	y d r s c	y	m sa	g	d	Nov., Feb.
488	Overton	Ark.?	......	o c	l	g y r	y w	m sa	f	k	Nov., Feb.
489	Ozone	Ark.	8 yrs.	o c	s	y d r	y	m sa	f	k	Dec., Jan.
490	Palmer	N. Z.	......	r o	m—l	g y	g y	b sa	g	k	Dec., Feb.
491	Palouse	Wash.	......	ob c	l	y r s	y	sa	vg	d	Oct., Dec.
492	Paragon	Tenn.	......	r c	m—l	g y r s	y	sa	g—vg	d k	Jan., May
493	Park	N. Y.	......	r c	m—l	y r s	y	m sa	vg	d	Dec., Mar.
494	Parlin	Me.	......	r o c	m—l	y r s	y	m sa	g	d	Oct., Feb.
495	Parry White	Pa.?	......	r ov	m	y w b	w	sa	g	d	Aug., Sept.
496	Parson	Mass.	......	r c	l	y r	w	s	g—vg	d	Nov., Feb.
497	Patten	Ia.	......	r o	m—l	g y b	y	sa	g	k	Oct., Jan.
498	Paul Long	Rus.	......	r c	m	g y r	y w	s	g	k	Oct., Nov.
499	Pawpaw	Mich.	......	r ob c	l	y r s	y	sa	g—vg	d	Dec., June
500	Payne	Mo.	......	r c	m	g y r s	y	m sa	g—vg	d	Jan., June
501	Peach	Unk.	......	o c	m	y b	w	b sa	g—vg	d	Dec., May
502	Peach (Montreal)	Fr.	......	r ob c	l	y w b	....	sa	g	d k	Sept.
503	Peach Blow	Me.	......	r o c	l	g y b	y	sa	f	k	Oct., Nov.
504	Peach Pond	N. Y.	......	o c	m—s	y r s	....	s	vg	d	Sept., Nov.
505	Pear	Pa.	......	r ob	s	y r s	y w	m sa	f	k	Sept., Nov.
506	Pearsall	N. Y.	......	r	l	y r s	y	s	g	k	Nov., Jan.
507	Pease	Conn.	......	r c	l—m	y g r s c	w y	sa	g—vg	d	Oct., Jan.
508	Peasgood	Eng.	......	r o	l	y r s	y	sa	g	k	Sept., Oct.
509	Peck *Pleasant*	R. I.	7 yrs.	r o c	m—l	y b	y	sa	vg—b	d k	Nov., Feb.
510	Pennock	Pa.	......	r o c	l	g y r s	y	m sa	f—g	k	Dec., Apr.
511	Peron	Mex.	......	r ob c	s	y b	g w	b sa	p	k	Jan., Mar.
512	Perry	O.	......	o	m	y r s	y	sa	g	k	Jan., May
513	Perry Red	N. Y.	......	o	m	y r s	w	sa	g—vg	d	Oct.
514	Perry Russet	R. I.?	......	r o c	m—l	y ru	y	sa	g	d k	Dec., Feb.
515	Persian	Rus.	10 yrs.	r ob	s	y r	w	m sa	g	k	Sept.
516	Peter	Minn.	......	r o	m	y r s	y	m sa	g—vg	d k	Sept., Oct.
517	Pewaukee	Wis.	5 yrs.	r o	m—l	y g r s	w	sa	f—g	k	Nov., Apr.
518	Pickard	Ind.	......	r o	l	g y b	y	sa	vg	d	Nov., Feb.
519	Pifer	Pa.	......	r o	m	g y r s	y	m sa	f	k	Jan., July
520	Pine Stump	N. C.	......	r o	m	y r	y	sa	g	k	Nov., Feb.
521	Pioneer	Aust'lia.	......	r c	m	y b	g w	sa	f—g	k	Jan., Apr.
522	Plumb Cider	O.?	......	r c	m	y r s	w	b sa	g	k	Oct., Jan.
523	Pomme Grise	Fr.?	5 yrs.	o r	s	y ru	y	sa	vg—b	d	Dec., Feb.
524	Pomona	Eng.	......	o c	m—vl	g y r s	w	sa	g—vg	k	Sept., Oct.
525	Porter	Mass.	......	ob c	s—l	y b	y	sa	g—vg	d k	Sept., Nov.
526	Pound Sweet	This name has been applied to several varieties of large sweet apples.									
527	Pratt *Sweet*	N. Y.	......	r c	l	y r s	y w	s	vg	d	Dec., Mar.
528	Priestly	Pa.	......	r ob	l—m	g y r s	y	m sa	g	d k	Dec., Apr.
529	Primate	N. Y.	3 yrs.	r o c	m—l	y g b	w	sa	vg—b	d	Aug., Sept.
530	Prince Albert	Eu.	......	r c	l	y g r s	y	b sa	g	k	Nov., Feb.

[illegible], irregular; o, oblate; ob, oblong; ov, ovate; r, roundish. *Color.*— b, blush; c, carmine; d, dark; g, green; s, subacid. *Quality.*— b, best; g, good; f, fair; p, poor; v, very. *Use.*— d, dessert; k, kitchen.

No.	Long Island.	Hudson Valley.	St. Lawrence and Champlain Vl'ys.	Mohawk Valley.	Eastern Plateau.	Central Lakes.	Ontario Shore.	Erie Shore.	Western Plateau.	REMARKS.
471										Not desirable.
472										Unworthy of consideration.
473										Too small to be valuable.
474										The same as Baldwin.
475	+	+	+	+	+	+	+	+	+	Resembles McIntosh.
476										Similar to Northern Spy; hardier. Inferior in quality.
477	+	+	+	+	+	+	+	+	+	Worth planting commercially.
478										
479										
480										
481										Not recommended.
482										Surpassed by other dessert apples of its season.
483										Yellow Bellflower group. Of good quality but skin tender.
484										Of no value.
485	+	+	+	+	+	+	+	+	+	Very similar to Northern Spy. Very promising.
486										Of no value.
487	+	+	+	+	+	+	+	+	+	Probably of value for fancy market.
488										Not recommended.
489										Not desirable.
490										Not recommended.
491										An inferior seedling of Tompkins King.
492										A southern variety not adapted to New York.
493										Probably obsolete.
494										Of no value.
495										Resembles Early Harvest. Later.
496										Of no value.
497										Seedling of Oldenburg. Worth trying in the North.
498										Of no value.
499										Not recommended.
500										Probably not well suited to this State.
501										Not recommended.
502										Cannot displace Oldenburg which is of the same season.
503										Not recommended.
504										Long known, but has failed to establish itself.
505										A worthless variety.
506										A Queens County seedling; apparently obsolete.
507										Grown for home use and local market.
508										Scarcely tested; of no value.
509										Shy bearer, subject to diseases. Fruit excellent.
510										Not desirable.
511										Type of Lady. Worthless.
512										Surpassed by better varieties.
513										Not valuable.
514										Excelled by other russets of its season.
515										Of no value.
516										Resembles Wealthy and does not surpass it.
517										Desirable only when hardiness is a prime requisite.
518										Not valuable.
519										Not recommended.
520										Not adapted to New York conditions. Southern.
521										Of no value.
522										Should give place to better sorts.
523										A small russet of high quality. Not profitable commercially.
524										An English sort of little value in America.
525	*	*		*	*	*	*	*	*	Has many merits for home use and local market.
526										
527										An old variety now practically obsolete.
528										Surpassed by standard varieties.
529	*	*	*	*	*	*	*	*	*	Tree characters poor. Valuable for dessert and local market.
530										Of no value.

ABBREVIATIONS.— *Size.*— l, large; m, medium; s, small; v, very. *Form.*— a, angular; c, conical
l, light; r, red; ru, russet; s, striped; w, white; y, yellow. *Flavor.*— a, acid; b, brisk; m, mild; s, sweet
Starring.— *, recommended; **, well recommended; +, worthy of trial.

No.	VARIETY.	Origin.	Bearing age.	Form.	Size.	Color of skin.	Color of flesh.	Flavor.	Quality.	Use.	Season.
531	Prince Double	Rus		r c	l	g y r s	y w	sa	f	k	Sept., Oct
532	Princess Fossia	Rus		r c	m	g y ru	y	m sa	g	k	Nov., Fe
533	Princess Wilhelma	Rus		o c	m	y b	w	a	f—g	k	Nov., De
534	Prolific Sweeting	Rus		r o	m	w y	w	s	g	d	Sept., Oct
535	Pryor	Va.?		r o	m—l	g y r s	y	sa	vg—b	d k	Dec., Ma
536	Pumpkin Russet	N. Eng.	9 yrs.	r o	l	g y ru	wy	s	g	k	Sept., Oct
537	Pumpkin Sweet	Conn.	9 yrs.	r c	l—vl	g y	w	s	g	k	Oct., Jan
538	Purity	Unk		r o c	l	g y b	g w	sa	f	k	Sept., Oc
539	Queen	Unk		o	l	g y r s	g w	b sa	g	k	Oct., De
540	Queen (West)	Unk		o	m	y b	g y	sa	g	k	Jan., Ma
541	(I) Quince (of Cole)	Me		r o c	l—vl	y b	y w	b sa	g—vg	k	July, Sep
542	(II) Quince (of Coxe)	N. Y.?		r o	l	y	y w	sa	g—vg	k	Nov.
543	Ralls	Va.?	5 yrs.	r o c	m	y r s c	w y	sa	vg	d k	Dec., Ma
544	Rambo	Pa.?		r o	m	g y r s	g w	m sa	g—vg	d	Nov., De
545	Ramsdell Sweet	Conn.?		ob c	l—m	y r s	y	vs	g—vg	d k	Oct., Fe
546	Raspberry	Rus		ob	s	y r	....	sa	vg	d	July, Au
547	Red and Green *Sweet*	Unk		ob c	l—vl	y r s	w	s	f—g	k	Aug., Se
548	Red Astrachan	Rus	5 yrs.	r c	m—l	y r s	w	b sa	g—vg	d k	Aug., Se
549	Red Canada	N. Eng.?		r c	m	y r s	w	m sa	g—b	d k	Nov., Ma
550	Red Carver	Pa		r o c	m—l	g y r s	y w	m sa	f	k	Oct., De
551	Red Hook	N. Y		r c	l—vl	y r s	....	sa	g	k	Aug., Se
552	Red June	N. C		r o	s—m	y r	w	b sa	g—vg	d k	Aug., Oc
553	Red Queen	Rus.?		r c	l	g y b	g y	sa	p	k	Nov., Ja
554	Red Russet	A bud sport of Baldwin differing only n having a russet skin. less valuable than Baldwin.									Consider
555	Redstreak	Eng		ob	s	y r s	y	sa	g	k	Dec., Ap
556	Red Transparent	Rus		r	m	y r	g w	sa	g—vg	k	Aug.
557	Red Wine	Eu		r o	m	w r	v w	sa	g	k	Aug., Se
558	Red Winter Sweet	Ill		r o c	m	y b	y w	s	g	k	Dec., Fe
559	Reed	N. Y		r	m	y w r s	w	sa	g	k	Nov.
560	Regmalard	Fr.?	12 yrs.	r o	l	g y b	y	sa	g	k	Nov., Ja
561	Reinette Pippin	Fr		o	m—l	w y	w	sa	g	d k	Oct., Fe
562	Rensselaer	N. Y	5 yrs.	r c	l	y b r	y	sa	g	d	Dec., Fe
563	Repka	Rus	9 yrs.	r o c	m—s	y w	w	m sa	g	k	Aug., Se
564	Repka Malenka	Rus		r c	m—s	y r s	....	m sa	g	k	Jan., Ap
565	Rhode Island *Greening*	R. I	5 yrs.	r o	l	y g	y	sa	vg	d k	Oct., Ma
566	Ribston	Eng		r c	m—l	y r s	y	sa	vg	d k	Oct., De
567	Richard Early Winter	Unk		r ob c	l	y r s	w y	m sa	f	k	Oct., De
568	Richard Graft	N. Y		r o	m	y r s	y	sa	vg	d	Sept.
569	Ridge	Pa.?		r ob c	l—m	y b	w y	m sa	g	k	Feb., Ma
570	Ringstads	Swed		r o c	m—s	g r s	g w	sa	g	k	Aug., Se
571	Rioter	Unk		r o	m—s	g y r s	y w	m sa	f	k	Sept., Oc
572	Rittenhouse	N. J		r o c	m	y b	y	s	g	k	Oct., No
573	Rock Pippin	Ohio?		r o	m	y g b	w y	sa	g	k	Feb., Ju
574	Rockland	N. Y		r o	m—l	y d r s c	y	sa	g	d k	Nov., J
575	Rolfe	Me		r o	m—l	y b	w y	b sa	g	k	Oct., De
576	Roman Stem	N. J		r	m—s	w y b	y	sa	vg	d	Oct., De
577	Romanite	Unk		r c	s	y r	y	sa	g	d k	Mar., Ju
578	Rome	O	2 yrs.	r o c	l	g y r s	y	sa	g	k	Nov., M
579	Romna	Rus		o c	m—l	g y r	w y	b sa	f—g	k	Sept., Ja
580	Ronk	Ind		r o	m	y r	w	sa	g	d	Oct., Fe
581	Roseau	Eu.?		o	m—l	g r	....	sa	g	k	Dec., Fe
582	Rose Red	N. Y.?		o	m	w r s	w	sa	vg	d	Sept., N
583	Roxbury	Mass		r o	l—m	y ru	y w	sa	g—vg	d k	Dec., M
584	Ruby Gem	N. Y.?		o	m	g y r s	g w	m sa	g	k	Sept.
585	Rudolph	Eu		r o	m	g y r	w y	b sa	g	k	Nov., F
586	Russian Baldwin	Rus		r o	m	y r s	y w	m sa	g	k	Jan., M
587	Rutherford	Ark	13 yrs.	r ob c	m	g y r s c	y	sa	p	k	Jan., Ap
588	Rutledge	Tex		r	m	y r s	y	m sa	f—g	k	Nov., M
589	Safstaholms	Swed		ob c	m—l	y r s	w	m sa	g	d	Oct., De

i, irregular; o, oblate; ob, oblong; ov, ovate; r, roundish. *Color.*— b, blush; c, carmine; d, dark; g, green; s, subacid. *Quality.*— b, best; g, good; f, fair; p, poor; v, very. *Use.*— d, dessert; k, kitchen.

No.	Long Island.	Hudson Valley.	St. Lawrence and Champlain Vl'ys.	Mohawk Valley.	Eastern Plateau.	Central Lakes.	Ontario Shore.	Erie Shore.	Western Plateau.	REMARKS.
531										Not valuable.
532										Of no value.
533										A worthless variety.
534										May be grown in northern New York.
535										Not well adapted to this region. Southern.
536										Should give place to others of better quality.
537	**	**		*	*	**	**	**	*	Valued for home and market purposes.
538										Of no value.
539										May be identical with Buckingham. Of no value.
540										Not recommended.
541										Supplanted by better sorts.
542										Obsolete.
543										Too small. Blossoms very late.
544										Tender tree; productive to a fault; excellent quality.
545										Without commercial value.
546										A substitute for Red June where that sort winter kills.
547										Of no value.
548	**	**	**	**	**	**	**	**	**	Succeeds under many conditions. Home and local markets.
549	*	*	*	*	*	**	**	*	*	Excellent.
550										Not recommended.
551										Grown only in the vicinity of Red Hook, N. Y.
552										Small, scabby, imperfect in New York.
553										A worthless variety.
554										
555										An old cider variety now obsolete in New York.
556										Without value where Primate can be grown.
557										Worthless.
558										Not recommended.
559										Not worth planting.
560										Well thought of in France but of little value in New York.
561										Excelled by Rhode Island Greening.
562	+	+	+	+	+	+	+	+	+	Type of Jonathan with high flavor.
563										Much inferior to Primate with which it competes.
564										Fruit too small to be valuable.
565	**	**	*	**	**	**	**	**	**	The standard green apple of New York.
566										Belongs with Hubbardston which greatly excels it.
567										Of no value.
568										Of but little value outside of the Hudson Valley.
569										Excelled by others of its season.
570										Cannot be recommended.
571										Not recommended.
572										Of no value.
573										One of the latest keepers.
574	+	+	+	+	+	+	+	+	+	Of excellent quality.
575										Tree very hardy, otherwise without merit.
576										Superseded by better sorts.
577										Not recommended.
578	**	**		*	*	**	**	**	*	A standard commercial variety.
579										Not worthy of attention.
580										Worthless.
581										Identity not certain.
582										Discarded.
583	**	**	*	**	**	**	**	**	**	A leading commercial variety.
584										Not valuable.
585										Of no value.
586										May be valuable in northern New York.
587										Of no value.
588										Of doubtful value. Very hardy.
589										Of very doubtful value.

ABBREVIATIONS.— *Size.*— l, large; m, medium; s, small; v, very. *Form.*— a, angular; c, conical; l, light; r, red; ru, russet; s, striped; w, white; y, yellow. *Flavor.*— a, acid; b, brisk; m, mild; s, sweet; *Starring.*— *, recommended; **, well recommended; +, worthy of trial.

No.	VARIETY.	Origin.	Bearing age.	Form.	Size.	Color of skin.	Color of flesh.	Flavor.	Quality.	Use.	Season.
590	Sailee Russet	N. Y.		o c	m	g ru	w	sa	g	d	Dec.
591	Sailly	N. Y.		r c	m	g y b	....	sa	g	k	Sept.
592	St. Lawrence	Am.		o c	l—m	y r s c	w	m sa	g—vg	d	Sept., Oct.
593	St. Peter	Rus.		r o	s	g y r s	w	m sa	f	k	Aug.
594	Salisbury	N. Y.		r	m—l	y	....	sa	g—vg	d k	?
595	Salome	Ill.		r o c	m	y r s	w y	sa	g—vg	d k	Nov., Mar.
596	Sandy Glass	Rus.		r o	l—m	g y b	w	b sa	f—g	k	Sept., Nov.
597	Saratoga	N. Y.	5 yrs.	r o c	l	g y r	w y	sa	g	k	Jan., Apr.
598	Savewell	N. Y.		r o c	m	w y b	y	sa	g	k	Feb., Mar.
599	Saxton	Mass.?		r o	m	y r s	y	sa	g—vg	d	Sept.
600	Scarlet Cranberry	Va.		r o	m	y r s	w	m sa	f—g	k	Feb., May
601	Scarlet Pippin	Can.		r	m	y r s	w	m sa	vg	d k	Oct., Dec.
602	Schenectady	N. Y.	5 yrs.	r c	l	g y r c	y w	sa	g	k	Nov., Jan.
603	Schodack	N. Y.?		r o	m	y g r	w y	b sa	f—g	k	Feb., June
604	Schoharie	N. Y.	6 yrs.	r ob c	l	y d r s	y	m sa	g	d k	Nov., Mar.
605	Schoonmaker	Unk.		r o	l	g y b	y w	b sa	vg	d k	Jan., Mar.
606	Schuyler *Sweet*	N. Y.		r o	l	y	w	s	g—vg	d	Sept., Oct.
607	Scollop Gilliflower	Eu.?		r c	m—l	y r s	y	m sa	g	k	Nov., Feb.
608	Scott	Vt.		r o c	m	g y r s	y w	b sa	g	k	Dec., Mar.
609	Scott Best	N. Y.		r o	m—l	y r s	w	sa	g—vg	d	Nov., Dec.
610	Scribner	N. Y.		r c	m	y r s	w y	sa	vg	d	Dec., Feb.
611	Sekula	Unk.		o	l	g y d r	g w	m sa	f	k	Dec., Mar.
612	Seneca	N. Y.		r ob c	l	y b	y	sa	vg	d	Nov., Jan.
613	Shackleford	Mo.		r ov	m—l	g y r s	y	m sa	f—g	k	Nov., Apr.
614	(I) Shannon	Ark.		o c	l	w y b	y	sa	g—vg	d k	Nov., Apr.
615	(II) Shannon	O.		r o c	l—m	y b	w y	m sa	g	d k	Nov., Apr.
616	Sharp	Md.?		r o	m	y b	w	m sa	vg	d	Sept., Oct.
617	Sheddan	Tenn.		r o	l—m	g y r b	y	m sa	g—vg	d	Jan., May
618	Shepherd Perfection	Unk.		r o c	m	g y d r	y	m sa	g	d	Nov., Jan.
619	Sheriff	Pa.		r o	m—s	y r s	w	m sa	g	k	Dec., Feb.
620	Sherman	N. Y.		o	m	g y b	....	s	g—vg	d	Nov., Jan.
621	Shiawassee	Mich.		o c	m—l	y r s	v w	sa	g—vg	d	Oct., Jan.
622	Shirley	Texas		r o c	m—s	y r s	w	m sa	f—g	k	Dec., May
623	Sigfried	Unk.		o c	m	g r s	g w	b sa	g	k	Mar., May
624	Sine-Qua-Non	N. Y.		r c	m	g y	w	m sa	g	d	Aug.
625	Skank	Unk.		r c	l	y r s	y	m sa	g—vg	d	Oct., Feb.
626	Skelton	Ark.	7 yrs.	r c	l	g y r s	y	m sa	f—g	k	Aug., Sept.
627	Sleight	A facsimile of Lady, except it is larger and ripens earlier. Not known outside of Dutchess County.									
628	Slingerland	N. Y.		r o	m—l	y r s	w	sa	g—vg	d	Dec., Feb.
629	Smith Cider	Pa.		r o c	m—l	g y r s	w	sa	g	k	Nov., Mar.
630	Smokehouse	Pa.		r o	m—l	g y r s	y	m sa	g	d k	Oct., Mar.
631	Snyder	Pa.?		r o	l	g b	w y	sa	f	k	Feb., May
632	Somerset (N. Y.)	N. Y.?		r c	m—s	w y ru	w	sa	vg—b	d	Sept., Oct.
633	Sops-of-Wine	Eng.	5 yrs.	r	m	g y r	w	m sa	g	k	Aug., Oct.
634	Sour Bough	N. Y.		r c	m	y	w	b sa	g	k	Sept.
635	Spasovka	Rus.		r o	l	g y r s	g w	sa	f	k	Aug.
636	Spectator	N. Y.		r ob	m	y b	w	sa	f—g	k	Sept.
637	Springdale	Ark.		r o	m	y r s c	g y	m sa	f	k	Jan., Mar.
638	Springport	N. Y.		r ob	m	g y	y w	sa	vg	k	Dec., May
639	Stanard	N. Y.		r o c	l	g y r s	y w	b sa	g—vg	k	Oct., Mar.
640	Stark	O.		r c	l—m	y r s	y	m sa	f—g	k	Jan., June
641	Starkey	Me.		o c	m—l	y r s	w	sa	vg	d	Oct., Jan.
642	Starr	N. J.	6 yrs.	r o	vl—l	y g	w	sa	vg	d	Aug., Sept.
643	Stayman Winesap	Kan.		r c	m—l	y r s	y	sa	g—vg	d	Dec., May
644	Sterling	Mass.		r c	l	y r	y	m sa	vg	d	Dec., Apr.
645	Sterns	N. Y.		o c	l	y r	y	m sa	g	k	Sept., Nov.
646	Stewart Seedling	Unk.		r c	m	g y r	g w	sa	g	k	Jan., Apr.
647	Stillman	N. Y.		r c	s	y b	y	sa	g	k	July, Aug.
648	Stone	Vt.?		r c	l	y d r s	w y	m sa	g—vg	d k	Nov., Feb.

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No.	Long Island.	Hudson Valley.	St. Lawrence and Champlain Vl'ys.	Mohawk Valley.	Eastern Plateau.	Central Lakes.	Ontario Shore.	Erie Shore.	Western Plateau.	REMARKS.
590	...	...	...	...	...	...	...	...	...	Inferior to Roxbury.
591	...	...	...	...	...	...	...	...	...	Discarded.
592	...	...	...	...	...	...	...	...	...	Suitable only for northern regions.
593	...	...	...	...	...	...	...	...	...	Not valuable.
594	...	...	...	...	...	...	...	...	...	Known only in the vicinity of Cortland. Value doubtful.
595	...	...	...	...	...	...	...	...	...	Excelled by standard sorts.
596	...	...	...	...	...	...	...	...	...	Worthless.
597	+	+	+	+	+	+	+	+	+	Type of Ben Davis but quality much superior.
598	...	...	...	...	...	...	...	...	...	Worthless.
599	...	...	...	...	...	...	...	...	...	Worthless.
600	...	...	...	...	...	...	...	...	...	Southern. Does not mature here.
601	...	...	...	...	...	...	...	...	...	Worth planting where Fameuse succeeds.
602	+	+	+	+	+	+	+	+	+	Promising as a good market variety.
603	...	...	...	...	...	...	...	...	...	Valuable only as a remarkably late keeper.
604	+	+	+	+	+	+	+	+	+	Type of Northern Spy. Promising.
605	...	...	...	...	...	...	...	...	...	Worthless.
606	...	...	...	...	...	...	...	...	...	Probably lost to cultivation.
607	...	...	...	...	...	...	...	...	...	Obsolete.
608	...	...	...	...	...	...	...	...	...	Valuable in elevated and northern regions.
609	...	...	...	...	...	...	...	...	...	Has no recognized value.
610	...	...	...	...	...	...	...	...	...	Probably obsolete.
611	..	+	+	+	+	+	+	+	+	New and worth testing.
612	...	...	...	...	...	...	...	...	...	Possibly of value for the home orchard.
613	...	...	...	...	...	...	...	...	...	Ben Davis group but less desirable.
614	...	...	...	...	...	...	...	...	...	Resembles Ohio Pippin. Lacking in productiveness.
615	...	...	...	...	...	...	...	...	...	Worthless.
616	...	...	...	...	...	...	...	...	...	Resembles Maiden Blush but is not equal to that variety.
617	...	...	...	...	...	...	...	...	...	Surpassed by better varieties.
618	...	...	...	...	...	...	...	...	...	But little tested in New York. May have value.
619	...	...	...	...	...	...	...	...	...	Very hardy. Of no consequence otherwise.
620	...	...	...	...	...	...	...	...	...	Worthless.
621	...	...	...	...	...	...	...	...	...	Excelled by McIntosh, which it resembles.
622	...	...	...	...	...	...	...	...	...	Ben Davis group but inferior to that sort.
623	...	...	...	...	...	...	...	...	...	Of no value as far north as New York.
624	...	...	...	...	...	...	...	...	...	Supplanted by better sorts.
625	...	...	...	...	...	...	...	...	...	Of high quality.
626	...	...	...	...	...	...	...	...	...	Not recommended.
627	...	...	...	...	...	...	...	...	...	
628	...	...	...	...	...	...	...	...	...	Of no value.
629	...	...	...	...	...	...	...	...	...	Unsatisfactory and unprofitable in New York.
630	...	...	...	...	...	...	...	...	...	Its cultivation is not being extended in New York.
631	...	...	...	...	...	...	...	...	...	A good keeper.
632	...	...	...	...	...	...	...	...	...	Without merit.
633	...	...	...	...	...	...	...	...	...	Superseded by better varieties.
634	...	...	...	...	...	...	...	...	...	Unprofitable for any purpose.
635	...	...	...	...	...	...	...	...	...	Of no value.
636	...	...	...	...	...	...	...	...	...	Without value.
637	...	...	...	...	...	...	...	...	...	Not recommended.
638	...	...	...	...	...	...	...	...	...	Unproductive and unprofitable.
639	...	...	...	...	...	...	...	...	...	Worthless.
640	*	*	...	...	*	*	*	*	*	Considered valuable in some sections of New York.
641	...	...	...	...	...	...	...	...	...	Appears to be worthy of testing for the north.
642	...	...	...	...	...	...	...	...	...	Worthy of testing where a fruit of its type is desired.
643	...	...	...	...	...	...	...	...	...	Not adapted to New York.
644	...	...	...	...	...	...	...	...	...	Apparently obsolete.
645	...	...	...	...	...	...	...	...	...	Of the Alexander type. No better than that variety.
646	...	...	...	...	...	...	...	...	...	Of no value.
647	...	...	...	...	...	...	...	...	...	Discarded.
648	...	...	**	...	...	...	...	...	...	Blue Pearmain group. Valuable in Northern New York.

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No.	VARIETY.	Origin.	Bearing age.	Form.	Size.	Color of skin.	Color of flesh.	Flavor.	Quality.	Use.	Season
649	Stowe	Me.	......	r c	m—l	g y b	y	sa	g	k	Dec., Mar
650	Streaked Pippin	N. Y.	......	r ob c	l	g y r s	w y	sa	g—vg	d k	Nov., Mar
651	Striped Gilliflower	Unk.	......	r ob c	l—vl	y w r s	y w	b sa	f—g	k	Sept.
652	Striped July	Tenn.	......	r o c	s—m	g y r s	y w	sa	g	k	Aug., Sept
653	Striped Winter	Rus.	10 yrs.	r ov	m	g y r s	y	m sa	f	k	Sept.
654	Stroat	N. Y.	......	r c	m—l	y g	y	b sa	g—vg	d	Sept., Nov
655	Strode	Pa.	......	ob c	m	y	y	sa	g—vg	d	Sept., Nov
656	Stuart Golden	O.	......	r o	m	y b	w y	m sa	vg	d	Dec., May
657	Stump	N. Y.	7 yrs.	r ob c	m—s	w y r s	w y	sa	vg	d	Sept., Oct
658	Stymus	N. Y.	......	o c	m	y r s	w	m sa	vg	d	Oct., Nov
659	Suffolk	N. Y.	......	r o	m	y w	w	sa	g	k	Aug., Sept
660	Summer Bellflower	N. Y.	......	r ob c	m—l	y	w	sa	g	k	Aug., Sept
661	Summer Harvey	N. B.?	......	r o	l	g y b	w	b sa	g	k	Aug.
662	Summer Pearmain	Am.	......	r ob c	m	g y r	y	m sa	b	d	Aug., Sept
663	Summer Queen	Unk.	......	r c	m—l	y r s	y	sa	g—vg	k	Aug., Sept
664	Summer Rambo	Fr.	......	o	l—vl	y r s	y	m sa	g	k	Sept., Nov
665	Summer Redstreak	N. Y.	......	r o c	m	y r s	w	b sa	g	k	Sept.
666	Summer Rose	N. J.	......	r o	s—m	y r s	w	m sa	g—vg	d k	July, Aug.
667	Summer Spitzenburg	N. Y.	......	r c	m	w r s	y w	sa	g—vg	d	Aug., Sept
668	Summer Sweet	Conn.	......	o c	m	y ru	w	s	g—vg	k	Sept.
669	Summer Wafer	Ala.?	......	o	m	g y d r c	y	sa	f	k	Sept., Oct.
670	Superb Sweet	Mass.	......	r c	m	g y r s c	g w	s	f	k	Sept., Oct.
671	Sutton	Mass.	9 yrs.	r	m	y r s	w	m sa	g—vg	d k	Nov., Mar.
672	Swaar	N. Y.	......	r o	l—m	g y	y	m sa	vg—b	d	Nov., Apr.
673	Swayzie	Can.	......	r o c	s	y ru	g y	m sa	vg—b	d	Dec., Mar.
674	Sweet and Sour	Unk.	......	o	m—l	y g	y	sa	f—g	k	Dec., Feb.
675	Sweet Bough	Am.	......	r ob c	l—m	g y	w	s	g—vg	d k	Aug., Sept.
676	Sweet Fall Pippin	N. Y.	......	o	l	g y	....	s	g	d k	Oct., Nov.
677	Sweet Greening	Mass.?	......	r o	m—l	y g b	w	s	g—vg	k	Dec., Apr.
678	Sweet Jonathan	Mo.?	......	r ov	m	y d r	g y	s	f	k	Nov., Feb.
679	Sweet King	N. Y.	......	r c	m	y r s	w	s	g—vg	d	Oct., Mar.
680	Sweet Romanite	Unk.	......	r o	m	g y r s	y w	s	g	k	Dec., Mar.
681	Sweet Russet	Unk.	......	o	m	y ru	w	s	g—vg	d	Nov., Mar.
682	Sweet Winesap	Pa.	......	r c	m—l	w y r s	w y	s	g—vg	d k	Nov., Apr.
683	Swenker	Pa.?	......	r o c	m—l	y r s	y	m sa	f	k	Nov., Mar.
684	Switzer	Rus.	......	r o	m	w y r	w	m sa	g	d	Aug., Oct.
685	Sylvester	N. Y.	......	r o	m—s	w b	v w	b sa	vg	k	Sept., Oct.
686	Tart Bough	Two varieties under this name both of which are worthless.									
687	Taylor Seedling	Kan.?	......	r o	m—s	y b	y	s	f—g	k	Sept.
688	Terdika	Rus.	......	r o c	m	y g r	y w	m sa	g	k	Jan., Mar.
689	Tetofsky	Rus.	4 yrs.	r o c	m—s	g y r s	w	sa	f—g	k	July, Aug.
690	Tewksbury	N. J.	......	r c	s—m	y b	y	b sa	g	k	Jan., May
691	Texas	Unk.	......	r o c	m	y r c	y	m sa	g	k	Jan., May
692	Thaler	Almost identical with Yellow Transparent which excels it.									
693	Thompson	Ia.	5 yrs.	r c	m	w y r s	w	sa	f—g	k	Oct., Dec.
694	Tinmouth	Vt.	......	r o	m—l	g y b	w y	m sa	g	k	Oct., Dec.
695	Tioga	N. Y.	......	r o c	l	w y b	y	b sa	g	k	Dec., Mar.
696	Titovka	Rus.	......	r ob	l	g y r s	y w	sa	g—vg	k	Aug., Sept.
697	Titus Pippin	N. Y.	......	ob c	l—m	g y	w y	sa	g—vg	d k	Nov., Mar.
698	Tobias	Vt.	......	o	m	y	y	sa	f—g	k	Nov., Apr.
699	Tobias Black	Vt.	......	r o	m—l	y g r s	g y	m sa	f—g	k	Nov., Apr.
700	Tobias Pippin	Vt.?	......	o c	m	y	w y	m sa	g	d k	Oct., Feb.
701	Tolman *Sweet*	Mass.	8 yrs.	r	m	y	w	s	g—vg	d k	Nov., Jan.
702	Tompkins King	N. J.?	5 yrs.	r c o	l—vl	y r s	y	sa	vg—b	d k	Oct., Jan.
703	Tom Putt	Eng.	......	r o c	l	y r s	g w	sa	f—g	k	Nov.
704	Transparent de Cronals	Rus.	......	r o	l	g y	y w	b sa	g	k	Sept.
705	Tufts	Mass.	......	r	l	y g r	y	m sa	f—g	d	Oct., Jan.
706	Twenty Ounce	Conn.	5 yrs.	r c	vl	g y r s	w y	sa	g	k	Sept., Dec.
707	Twenty Ounce Pippin	Unk.	......	r o	l—vl	g y r s	y	sa	f—g	k	Oct., Feb.

irregular; o, oblate; ob, oblong; ov, ovate; r, roundish. *Color.*— b, blush; c, carmine; d, dark; g, green;
. subacid. *Quality.*— b, best; g, good; f, fair; p, poor; v, very. *Use.*— d, dessert; k, kitchen.

No.	Long Island.	Hudson Valley.	St. Lawrence and Champlain Vl'ys.	Mohawk Valley.	Eastern Plateau.	Central Lakes.	Ontario Shore.	Erie Shore.	Western Plateau.	REMARKS.
649										A Maine seedling worthless in New York.
650										Has many good qualities for local market.
651										Obsolete.
652										Of no value.
653										Resembles Pewaukee. Not a winter apple. Of no value.
654										Passed from cultivation.
655										Surpassed by standard sorts.
656										Not recommended.
657	*	*		*	*	*	*	*	*	Desirable for home use and for local market.
658										Worthless.
659										Lost to cultivation.
660										Dropped by the American Pomological Society.
661										Not recommended.
662										Of value only as an amateur's fruit.
663										Worthless.
664										An old sort possibly worthy of re-testing.
665										Worthless.
666										Becoming obsolete.
667										Esteemed by some for home use.
668										Discarded.
669										Of no value.
670										Not recommended.
671	*	**		*	*					Desirable only in the Hudson Valley.
672	*	*		*	*	*	*	*	*	One of the best for the amateur. Requires deep, rich loam.
673										Similar to but inferior to Pomme Grise.
674										Worthless except as a curiosity.
675	**	**		**	**	**	**	**	**	A universal favorite for the home orchard and local market.
676										Gradually going out of cultivation.
677										Esteemed for home use. Seldom planted.
678										Not recommended.
679										Not cultivated outside of Nassau County. Worthless.
680										Not recommended.
681										Several known by this name. All worthless.
682	**	**		*	*	*	*	*	*	Attractive, excellent quality; reliable cropper; overbears.
683										Does not excel standard sorts for any purpose.
684										Resembles the Fameuse but inferior.
685										Without value.
686										
687										Of no value.
688										Not recommended.
689										Surpassed by other sorts of its season.
690										Not recommended.
691										Not recommended.
692										
693										Not worth planting.
694										Not desirable.
695	+	+	+	+	+	+	+	+	+	Very promising. Resembles Northern Spy except in color.
696										Perhaps worthy of planting in the North.
697										Good tree characters. Fruit attractive and well flavored.
698										Not worthy attention except for hardiness.
699										Hardy but not equal to standard varieties.
700										Not worth planting.
701	**	**		**	**	**	**	**	**	Hardy, vigorous, early bearer, reliable cropper.
702	*	*		*	**	**	**	*	**	Were the tree hardier, healthier, longer lived and more productive, it would be more commonly grown.
703										Unworthy.
704										Worthless.
705										Resembles the Baldwin; is less desirable.
706	**	**	*	*	*	**	**	**	*	One of the best fall varieties for home or market.
707										Often confused with Twenty Ounce. Of poor quality.

ABBREVIATIONS.— *Size.*— l, large; m, medium; s, small; v, very. *Form.*— a, angular; c, conica
l, light; r, red; ru, russet; s, striped; w, white; y, yellow. *Flavor.*— a, acid; b, brisk; m, mild; s, swee
Starring.— *, recommended; **, well recommended; +, worthy of trial.

No.	VARIETY.	Origin.	Bearing age.	Form.	Size.	Color of skin.	Color of flesh.	Flavor.	Quality.	Use.	Season.
708	Tyre................	N. Y....	......	r o	m	y r s	w	b sa	g	k	Sept.
709	Ulysses..............	N. Y....	......	o c	m	g y r s	y w	sa	f	k	Nov., De
710	Upp..................	O........	......	o c	m	y r	y	sa	f	k	Dec., Fe
711	Utter................	Ill.?......	......	r o	l—m	w y r s	w	m sa	g	k	Oct., De
712	Vandevere............	Del......	5 yrs.	r o	m	y r s	y	m sa	g—vg	k	Oct., Ja
713	Vandevere Improved...	Mo.?...	The same as Vandevere.								
714	Vandevere Pippin......	Pa.?.....	......	o c	l	y r s	w	b sa	g	k	Sept., No
715	Vanhoy...............	N. C.....	......	r o	m	y g r s	y	m sa	f	k	Jan., May
716	Ver..................	Unk......	......	r c	m	g y d r	w	s	f—p	k	Sept., No
717	Via..................	Va.......	......	r o	m	y r	y	sa	g	k	Dec., Feb
718	Victoria Sweet..........	N. Y.?..	......	r o c	m—l	y r s	y	s	g—vg	d k	Oct., Jan
719	Victuals and Drink.....	N. J......	......	r o c	l	g y b	w y	s	p	k	Sept.
720	Vineuse Rouge........	Rus......	......	r o c	m—l	g y r s	w	sa	g—vg	k	Aug.
721	Virginia Greening......	Va.?.....	......	o	m	g y b	y	m sa	f—g	k	Feb., Jun
722	Voronesh Red Summer.	Rus......	......	r o	m	y r s c	w	sa	f	k	Aug., Sep
723	Wabash Red..........	Ind.?....	......	r o	l—m	y r s	w y	m sa	g	d	Dec., Ma
724	Wagener..............	N. Y....	4 yrs.	r o	m—l	y r s	y	sa	vg—b	d k	Oct., Feb
725	Walbridge............	Ill........	......	r c	m	w y r s	w	m sa	f—g	k	Nov., Fe
726	Walker Beauty........	Pa.......	......	r c	m—l	y b	y	b sa	g	k	Nov., Ap
727	Wallace Howard.......	Ga.......	......	r ob	l—m	y r s	y w	m sa	g	d	Nov., Ma
728	Wandering Spy.......	Ark......	......	r c	l—m	y r	w	sa	g	k	Jan., Apr
729	Washington Royal.....	Mass....	......	r o	m	g y b	w	m sa	g—vg	d	Oct., Ma
730	Washington Strawberry.	N. Y....	......	r c	l	g y r s c	y	sa	g—vg	d	Oct., Dec
731	Water................	Pa.......	......	r ob c	m	g y b	w	m sa	g	d	Oct., Dec
732	Watwood............	Ky.......	......	o	m	w y b	y w	sa	g	k	Dec., Ma
733	Wealthy............	Minn...	6 yrs.	r o c	l—m	y r s	y w	sa	g—vg	d k	Oct., Jan
734	Wells................	Md.......	......	r	l	w g r s	y	sa	vg	d	Nov., Ma
735	Westchester..........	N. Y....	4 yrs.	r c	l	y b r	y	m sa	g—vg	d k	Nov., Ja
736	Western Beauty.......	For description, see Grosh.									
737	Westfield............	Conn...	9 yrs.	r c	m	y r s	y w	m sa	vg—b	d	Oct., Feb
738	Whinery............	O........	......	r o c	m—l	g y r b	y w	m sa	f—g	k	Jan., Ap
739	White Astrachan......	Rus......	......	r o	m	y w	w	b sa	g	k	Aug.
740	White Doctor.........	Pa.......	......	r o	l	g y	w	m sa	f—g	k	Nov., Ma
741	White Juneating.......	Eng......	......	r o	s	y w	w	sa	g—vg	d	Aug.
742	White Pearmain.......	Unk......	......	r ob c	m	g y b	y	m sa	vg—b	d k	Dec., Ma
743	White Pippin..........	Unk......	......	r o	m—l	g y	w	sa	g—vg	d k	Nov., Ma
744	White Spanish........	Spain....	......	r o	vl	y g	y w	sa	vg	d k	Oct., Jan
745	William Prince........	Unk......	......	o c	m—s	g w r s	w	m sa	f—g	d k	Aug.
746	Williams.............	Mass....	3 yrs.	r ob c	m	y d r s	y w	m sa	g	d	Aug., Sep
747	Willis Sweet..........	N. Y....	......	r	l	y r s	w	s	vg	d k	Aug., Sep
748	Willow...............	Va.?.....	......	r o c	l—m	y g r s	y g	sa	f—g	k	Jan., Ma
749	Willsboro............	N. Y....	......	r c	m	y r s	y w	sa	......	k	Dec., Fe
750	Windsor..............	Wis.....	7 yrs.	r c	m	y g r	y	m sa	g—vg	d	Dec., Ap
751	Wine................	Del......	......	r o	m	y r s	y w	sa	g—vg	k	Oct., Ma
752	Wine Rubets..........	Rus......	......	r	m—s	g b	....	m sa	f—g	k	Aug.
753	Winesap............	N. J.?...	5 yrs.	r c	s	y r s	y	sa	g—vg	d k	Jan., Ap
754	Winter Banana........	Ind......	5 yrs.	r o c	l	w y b	y	m sa	g—vg	d k	Nov., Ja
755	Winter Paradise.......	Pa.......	......	r o	l	g y b	w	s	vg	d	Nov., Ma
756	Winter Pearmain......	Several different varieties known under this name.									
757	Winter St. Lawrence...	Eng......	......	r c	m—l	g y r s	w	sa	g	d	Nov., Ja
758	Winthrop Greening....	Me......	......	o	l	y g	w	sa	g	k	Sept.
759	Wismer..............	Can.....	9 yrs.	r	m—l	y r s	y w	m sa	g—vg	d	Jan., Ap
760	Wolf River...........	Wis.....	6 yrs.	r o c	vl	g y r s	w	sa	f—g	k	Sept., De
761	Workaroe............	Rus......	......	r c	m—l	y r s	y w	m sa	g	k	Sept.
762	Yellow Bellflower......	N. J....	9 yrs.	r ob c	m—vl	w y b	y	b sa	g	k	Dec., Ap
763	Yellow Calville........	Rus......	......	o c	m	y	w	sa	f—g	k	Aug.
764	Yellow Forest.........	La.......	8 yrs.	r o	s—m	g y b	g w	m sa	g	d	Jan., Jun
765	Yellow Transparent....	Rus......	4 yrs.	r o c	m	w y	w	sa	g—vg	d k	July, Aug
766	Yopp................	Ga.......	......	r o c	m—l	g y b	w	sa	f—g	k	Oct., Nov
767	York................	Golden Pippin and Fall Pippin often pass under this name.									

i, irregular; o, oblate; ob, oblong; ov, ovate; r, roundish. *Color.*— b, blush; c, carmine; d, dark; g, green;
a, subacid. *Quality.*— b, best; g, good; f, fair; p, poor; v, very. *Use.*— d, dessert; k, kitchen.

No.	Long Island.	Hudson Valley.	St. Lawrence and Champlain Vl'ys.	Mohawk Valley.	Eastern Plateau.	Central Lakes.	Ontario Shore.	Erie Shore.	Western Plateau.	REMARKS.
708	...	...	....	...	...	...	...	...	...	Worthless.
709	...	...	....	...	...	...	...	...	...	A worthless variety.
710	...	...	....	...	...	...	...	...	...	Of no value.
711	...	...	....	...	...	...	...	...	...	Without value.
712	...	...	....	...	...	...	...	...	...	Passing out of cultivation.
713										
714	...	...	....	...	...	...	...	...	...	No longer listed by nurserymen.
715	...	...	....	...	...	...	...	...	...	Not desirable. Southern.
716	...	...	....	...	...	...	...	...	...	Worthless.
717	...	...	....	...	...	...	...	...	...	Not recommended.
718	...	...	....	...	...	...	...	...	...	A good sweet apple.
719	...	...	....	...	...	...	...	...	...	Worthless.
720	...	...	....	...	...	...	...	...	...	Worthless.
721	...	...	....	...	...	...	...	...	...	Valued in the South as a late keeper.
722	...	...	....	...	...	...	...	...	...	Of no value.
723	...	...	....	...	...	...	...	...	...	Tree qualities good. Attractive, high quality, late keeper.
724	*	*	....	*	*	*	*	*	*	Early bearer; heavy cropper; short lived. Good.
725	...	...	....	...	...	...	...	...	...	Of little value.
726	...	...	....	...	...	...	...	...	...	Unproductive and not desirable.
727	...	...	....	...	...	...	...	...	...	Southern. Of no value.
728	...	...	....	...	...	...	...	...	...	Of no value.
729	...	...	....	...	...	...	...	...	...	Not recommended.
730	...	...	....	...	...	...	...	...	...	Has failed to establish itself in the commercial orchards.
731	...	...	....	...	...	...	...	...	...	Dropped by the American Pomological Society.
732	...	...	....	...	...	...	...	...	...	Inferior to standard varieties.
733	**	**	**	**	**	**	**	**	**	Tree and fruit characters good. Small on old trees.
734	...	...	....	...	...	...	...	...	...	Worthless.
735	+	+	+	+	+	+	+	+	+	Type of Green Newtown.
736										
737	...	...	....	...	...	...	...	...	...	Tree qualities good. Uncertain in adaptability.
738	...	...	....	...	...	...	...	...	...	Not recommended.
739	...	...	....	...	...	...	...	...	...	Discarded by the American Pomological Society.
740	...	...	....	...	...	...	...	...	...	Not recommended.
741	...	...	....	...	...	...	...	...	...	Has nothing to recommend it.
742	...	...	....	...	...	...	...	...	...	Not recommended.
743	...	...	....	...	...	...	...	...	...	Tree qualities good. Surpassed by standard sorts.
744	...	...	....	...	...	...	...	...	...	Supplanted by better sorts.
745	...	...	....	...	...	...	...	...	...	Not equal to Red Astrachan. Not recommended.
746	...	...	....	...	...	...	...	...	...	Has some points of merit for commercial planting.
747	...	...	....	...	...	...	...	...	...	Worthless.
748	...	...	....	...	...	...	...	...	...	Southern. Surpassed by others.
749	...	...	....	...	...	...	...	...	...	Value unknown. Probably obsolete.
750	...	...	....	...	...	...	...	...	...	Very hardy. Promising for rigorous climates.
751	...	...	....	...	...	...	...	...	...	Handsome but not valuable.
752	...	...	....	...	...	...	...	...	...	Not recommended.
753	...	...	....	...	...	...	...	...	...	Both tree characters and fruit poor in New York.
754	*	*	....	*	*	*	*	*	*	Of value for home and local market.
755	...	...	....	...	...	...	...	...	...	Of little value.
756										
757	...	...	....	...	...	...	...	...	...	Worthless.
758	...	...	....	...	...	...	...	...	...	Dropped from cultivation.
759	...	...	....	...	...	...	...	...	...	Worth planting in the home orchard.
760	...	...	....	...	...	...	...	...	...	Of Alexander type. Hardly worth planting.
761	...	...	....	...	...	...	...	...	...	Undesirable.
762	*	*	....	*	*	*	*	*	*	Poor cropper. Valuable in some districts. Bruises easily.
763	...	...	....	...	...	...	...	...	...	Much inferior to standard sorts.
764	...	...	....	...	...	...	...	...	...	Of no value except as a very late keeper.
765	**	**	**	**	**	*	*	*	*	One of the best extra early sorts for home and market.
766	...	...	....	...	...	...	...	...	...	Practically worthless.
767										

ABBREVIATIONS.— *Size.*— l, large; m, medium; s, small; v, very. *Form.*—a, angular; c, conical; l, light; r, red; ru, russet; s, striped; w, white; y, yellow. *Flavor.*— a, acid; b, brisk; m, mild; s, sweet; *Starring.*— *, recommended; **, well recommended; +, worthy of trial.

No.	VARIETY.	Origin.	Bearing age.	Form.	Size.	Color of skin.	Color of flesh.	Flavor.	Quality.	Use.	Season.
768	York	Mass.	......	r c	m	y b	w	sa	g—vg	k	Oct., Nov.
769	York Imperial	Pa.	5 yrs.	r o	m—l	y r s	y	m sa	g—vg	d k	Jan., Mar.
770	York Stripe	Pa.	......	r c	l	g y r s	w	m sa	f	k	Oct., Dec.
771	Zoar	O.	9 yrs.	r o	m	g y r	y w	sa	f	k	Nov., Dec
772	Zolotareff	Rus.	......	r c	l	g y r s	g w	sa	g	k	Aug., Sept
773	Zusoff	Rus.	......	r o c	l	g y d r	w	sa	g	k	Oct., Nov.
	CRABAPPLES.										
774	Algerienne	Unk.	......	r ov	s	g y b	g w	sa	f	k	Sept., Oct.
775	Bailey	N. Y.	......	r c	m—l	y r	....	sa	g	k	Oct., Dec.
776	Brier	Wis.	......	r c	l	y r s	y	s	g	d	Sept., Oct.
777	Cherry	Unk.	......	o	s	y r s	y	m sa	g	k	Aug., Oct.
778	Coral	Ill.	......	r o	s	y b	y	m sa	g	d	Oct., Feb.
779	Currant	Unk.	......	o	s	y r s	y	sa	f—p	k	Oct., Nov.
780	Dartmouth	N. H.	......	r o	m—l	y r	y	m sa	g	k	Aug.
781	Excelsior	Minn.	......	r o	l	y r	w	sa	g—vg	d k	Sept.
782	Florence	Minn.	......	o	m	y w r	y	b sa	g	k	Aug., Sept.
783	Gibb	Wis.	......	r o	l	y b r	y	sa	g	k	Aug.
784	Grant	Minn.	4 yrs.	r o	s—m	g y r s	y w	sa	f	k	Sept., Oct.
785	Hohenheimer	Unk.	......	r o	s	y r	y	sa	g	k	Sept., Oct.
786	Hyslop	Unk.	......	r c	l—m	y d r	y	sa	g	k	Sept., Oct.
787	Large Red Siberian	Unk.	......	r	m	y r s	y	sa	g	k	Sept., Oct.
788	Large Yellow Siberian	Unk.	......	r	l	y b	y	b sa	g	k	Sept., Oct.
789	Marengo	Ill.	......	r o	l	y r	y w	sa	g	d k	Nov., Mar.
790	Martha	Minn.	......	o	m—l	y r	y	b sa	g—vg	d k	Sept., Nov.
791	Minnesota	Minn.	......	r	l	y	w	sa	g	k	Sept., Oct.
792	Montreal	Can.	......	r o	l	y r	y w	b sa	g	k	Sept., Oct.
793	Oblong	Unk.	......	ob c	m	y w r s	....	sa	g	k	Sept.
794	Orange	Am.	......	r o	m	y	y w	m sa	g	k	Sept., Nov
795	Paul Imperial	Eng.	......	o	s—m	y r	y	b sa	g	k	Sept., Oct.
796	Picta Striata	Unk.	......	o	m—l	g y r s	y	sa	g	k	Oct., Dec.
797	Quaker	Unk.	......	r o	m—l	y b	w y	sa	f	k	Oct.
798	Queen Choice	Unk.	......	r c	m	y r	y	sa	g	k	Oct.
799	September	Minn.	......	r ob c	m—l	y r s	y	sa	g—vg	d k	Sept.
800	Soulard	Mo.	......	o	vl	y r	w	a	p	k	Oct., Dec.
801	Transcendent	Am.	......	r ob c	m—l	y b	y	sa	vg	k	Aug., Sept.
802	Van Wyck	N. Y.	......	r c	l	w b	w	s	g—vg	d k	Aug., Sept.
803	Whitney	Ill.	......	r c	l	y r s	y	m sa	g—vg	d k	Aug., Sept.
804	Yellow Siberian	Eu.	......	r o	m—s	y	y	sa	g	k	Sept.

rregular; o, oblate; ob, oblong; ov, ovate; r, roundish. *Color.*— b, blush; c, carmine; d, dark; g, green; subacid. *Quality.*— b, best; g, good; f, fair; p, poor; v, very. *Use.*— d, dessert; k, kitchen.

	Long Island.	Hudson Valley.	St. Lawrence and Champlain Vl'ys.	Mohawk Valley.	Eastern Plateau.	Central Lakes.	Ontario Shore.	Erie Shore.	Western Plateau.	REMARKS.
8										Worthless.
9										Reports adverse to its culture in New York.
0										A worthless variety.
1										Of no value.
2										Inferior to Oldenburg.
3										Apparently surpassed by other varieties of its season.
4										Surpassed by other varieties.
5										Passed from cultivation.
6										Worthless.
7										An old variety, now little grown.
8										Worthless.
9										Very hardy but of no commercial value.
0										Lacks vigor. Excelled by other crabs.
1	*	*	*	*	*	*	*	*	*	One of the most desirable of its season.
2										Not desirable for commercial planting.
3	*	*	*	*	*	*	*	*	*	Recommended for home use and possibly for market.
4										Not recommended.
5										Not fully tested. Fruit runs small.
6	**	**	**	**	**	**	**	**	**	Widely and deservedly cultivated for home and market.
7										Better varieties are now preferred.
8										Superseded by better varieties.
9										A good late-keeping crab for home use.
0	**	**	**	**	**	**	**	**	**	One of the best.
91										Lacks productiveness at this Station.
92										Worthless.
93										Fails in New York.
94										Not recommended.
95										Does not find favor.
96										Unworthy.
97										Without special value.
98										Worthless.
99										Suitable for kitchen or dessert.
00										Has no value in the orchard.
01	**	**	**	**	**	**	**	**	**	Tree hardy, good grower, very productive. Very popular.
02										Worthless.
03	*	*	*	*	*	*	*	*	*	One of the most popular of the large crabs.
04										Valued for home use.

NEW OR NOTEWORTHY FRUITS.*

U. P. HEDRICK.**

Without new varieties, fruit-growing would be at a standstill. Old varieties are seldom improved; they are changed only when nature occasionally, very occasionally, substitutes one character for another, as when russet takes the place of red in the Baldwin or of yellow in the Bartlett. The varieties now grown are far from perfect, there being few, indeed, not more readily characterized by their faults than by their virtues. There is, all can agree, still much to be done in improving fruits — when nature gives us perfect varieties the Millennium will have come in fruit-growing. New varieties should be looked upon, then, as milestones in the march of progress and he who would keep up in the march must become familiar with the milestones.

But familiarity with fruit novelties is not easily acquired. To begin with, the names are often misleading, for the mid-wives of horticulture have a way of christening their new-born with descriptive terms which do not describe. Neither can the accounts of introducers be taken as precise statements of merits. To catch customers the introducer sets a net. The net is an illustrated catalogue baited with beautiful illustrations and alluring descriptions which tempt but do not always inform. Nor can it be expected in these days when novelties come from here, there and everywhere, that the fruit-grower can determine for himself the merits of new fruits — neither time, money nor breadth of knowledge suffices. The State should test the almost numberless new varieties of fruit. It is quite as much as the grower can do to try the cream of the new sorts — and this he should do.

Believing it to be the duty of the State to test new fruits, this Station grows on probation all of the fruit novelties offered in this country. In this bulletin we describe the best recent introductions as they grow on the grounds of this Station.

For one reason and another varieties are often lost; they pass from cultivation or remain for years or forever in the limbo of nurserymen's catalogues and horticultural reports. Others were born to blush unseen in places or times such that their good qualities

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* Reprint of Bulletin No. 364, July, 1913; for Popular Edition, see p. 755.

** Credit for the descriptions of fruits given herein is due Richard Wellington, Geo. H. Howe, Chas. B. Tubergen, and O. M. Taylor of the Horticultural Department of this Station.

have not been properly heralded. Some of these all but lost varieties when resurrected and given a second period of probation prove most worthy. Again, the defectives and unmanageables of a generation ago may, under modern methods, prove tractable and profitable. These are the "noteworthies" of the title — old sorts never tried, or not well tried, or one-time "unmanageables" which after a more careful test or with a better show, deserve the attention of fruit-growers.

APPLES.

Deacon Jones.— This apple is attracting much attention in western New York. It is of large size and when well colored is handsome, the yellow ground color being overlaid with an attractive red relieved with numerous prominent dots. In shape, the apple resembles Bellflower. The tree in nursery and in orchard is most thrifty, comes into bearing young, and is very productive and an annual bearer. The fruit hangs exceptionally well to the tree and there is almost no waste from windfalls and culls. On the grounds of this Station, Deacon Jones came into bearing at the age of four and for fifteen years it has not missed bearing a crop. The flesh is rather coarse; the flavor is mild and the quality, while good, unfortunately is not high. Its tough skin and firm texture make it a good shipper. Deacon Jones is well worth trial as a general purpose market apple.

The variety originated in Pennsylvania as a chance seedling on the farm of "Deacon" Jones. In the fall of 1890, cions were sent to a Mr. Freeman of Rochester, New York, who first propagated the variety.

Tree vigorous, upright-spreading, dense, very productive; branches long, slender, drooping. Fruit uniformly large to very large, often variable in shape, roundish-conic to oblong-conic, ribbed; stem short, thick; cavity shallow, narrow, obtuse to acute, usually smooth, very prominently lipped; calyx of medium size, partly open, often leafy, with lobes separated at the base; basin moderately deep, narrow, distinctly furrowed and wrinkled; skin thick, tough, slightly rough, waxen yellow, mottled and blushed with red, with irregular splashes of carmine, in highly colored specimens being almost completely covered with a handsome deep red, considerable light bloom; dots conspicuous, small and large, whitish, many areolar with russet point, numerous toward basin; core very large, very open; seeds numerous, medium in size; flesh yellowish-white, firm, coarse, crisp, tender, juicy, mild subacid, slightly aromatic, not high in quality but good; season November to March.

Delicious.— Delicious has created the sensation of the times in fruit-growing circles. Probably no new apple has been more widely talked about, more generally planted or better received by consumers and growers alike. Introduced in 1895, in the short time that has intervened, its culture has spread throughout the apple districts of the United States. In the orchards of the West and Northwest, it has been extensively planted, and according to all reports is proving a great commercial success. Delicious, as grown

in New York, is smaller and not as richly colored as the western grown fruit but is even better in quality — at least, so the Easterners think. All who have tasted Delicious — and who has not? — agree that its rich, distinctive flavor is its chief asset, though it has size and beauty as well. Contrary to the usual behavior of apples, the fruit of this variety, on the Station grounds, seems to increase in size and color as the trees grow older. In New York, the faults of Delicious are susceptibility to water-core and to softening of the flesh about the core and readiness to infection by the spores of apple scab. Delicious cannot be unqualifiedly recommended to commercial apple-growers in New York but it is well worth planting in a probationary way for money-making and every man should plant it in his home orchard.

Delicious was found in 1881 by Jesse Hiatt of Peru, Madison County, Iowa, and the original tree is still flourishing. Mr. Hiatt states that in 1896 while three-fifths of his orchard was injured by cold and drought, the Delicious has withstood the winter perfectly. "Hawkeye" was the name given by the Hiatt family to the apple and it was usually so called locally. Mr. Hiatt sold the variety to Stark Brothers of Louisiana, Missouri, about 1894 and it was commercially introduced by that firm in 1895 under the name "Delicious."

Tree large, vigorous, spreading, hardy, productive; branches smooth, stout; leaves large, thick, dark green. Fruit large, uniform, roundish-conic to oblong-conic, ribbed; stem long, medium thick; cavity deep, broad, often furrowed, flaring, greenish; calyx medium, nearly closed, with long, narrow, acute lobes; basin moderately deep, wide, abrupt, very strongly furrowed and corrugated; skin very thick, tough, smooth; color light yellow, nearly to almost entirely overspread with dark, attractive red, splashed and mottled with carmine; dots numerous, small, yellow; core medium in size; seeds of medium size; flesh yellowish, firm, a little coarse, tender, juicy, aromatic, pleasantly subacid, good to very good; season December to last of February.

Opalescent is one of the most attractive apples grown. It is large, shapely, nearly or quite covered with brilliant red on a yellow background — a veritable feast to the eye. In quality, too, it is excellent. While a comparatively new variety, Opalescent is well known by professional pomologists and now deserves more notice from fruit-growers. Its season ends in January, rather short for a commercial variety, but it ought to prove profitable for late fall and early winter. Cold storage, too, would prolong the season. The young trees on our grounds are hardy, vigorous and productive — all characters thus marking it as a promising variety for New York fruit-growers. We know of no other apple better endowed with characters fitting it to compete with the showy fruit from the West.

About 1899 McNary and Gaines, Xenia, Ohio, found a number of apple seedlings growing in an old orchard. One was saved and planted in a vacancy in a nearby row with the idea of top-grafting it when large enough. Fruit borne by this tree attracted attention

as being superior to anything in the orchard and the tree was allowed to grow; from it we have the Opalescent.

Tree vigorous, roundish, open, productive. Fruit uniformly large to very large roundish-conic, usually symmetrical, obscurely ribbed; stem short, slender; cavity deep, broad, acuminate, usually symmetrical, often russeted; calyx large, open, with small, obtuse, reflexed lobes; basin deep, wide, obtuse to acute, sometimes slightly furrowed, symmetrical; skin thick, rather tough, glossy, takes a brilliant polish; color bright pale yellow nearly or quite overspread with dark, deep red with faint splashes of purplish-carmine; dots numerous, small, conspicuous, yellowish or russet, often submerged, frequently mingled with irregular lines and flecks of russet, especially around the basin; core small; cells usually closed; seeds medium in size; flesh yellowish, firm, crisp, tender, juicy, pleasant mild subacid, aromatic, good to very good; season November to January.

PEAR.

Lucy Duke is supposed to have come from a seed of Bartlett fertilized by Winter Nelis. The fruit is of only medium size, made in the mold of Bartlett, of a beautiful golden russet color, all in all an extremely handsome pear. Its rich, juicy, spicy, melting flesh makes it of the very finest quality; for a choice dessert fruit Lucy Duke can hardly be surpassed. Though originating in the South, the tree is hardy, is also very productive but is only moderately vigorous, resembling Winter Nelis somewhat in habit of growth. The variety can be unqualifiedly recommended for local and fancy markets and we believe with its rather thick skin it would stand shipping well and that it might prove productive enough for general planting for the market. It is said — as of what new pear has it not been said — that Lucy Duke is blight proof. With Winter Nelis, as nearly immune to blight as any other pear, as a parent, and North Carolina, where none but pears that blight but little can grow, Lucy Duke ought to be relatively immune to blight. Just why this pear has been neglected is hard to see. Thomas Meehan said of it twenty-five years ago, "It is the finest large pear in cultivation;" while Charles Downing thought it "Not quite so fine as a first class Seckel but I must aver it is not far behind."

Lucy Duke was grown about 1880 by Mrs. Lucy Duke of Beaufort County, North Carolina, from seed of a California Bartlett. Its tree characters are so nearly like those of Winter Nelis that the other parent is supposed to be that variety.

Tree medium in size, a little lacking in vigor, upright, slightly spreading; branches moderately stout, somewhat shaggy. Fruit medium in size, uniform, acute to oblong pyriform, symmetrical; stem short, thick, slightly curved; cavity obtuse, shallow, narrow, russetted, wrinkled and raised around the base of the stem; calyx large, open, with short, broad, acute lobes; basin medium in depth and width, obtuse, symmetrical; skin medium thick, tough, rough, entirely covered with a solid, deep dark russet coat, changing to golden russet and mingled with flecks of russet; dots numerous, small, russet, obscure; core large, closed; seeds large; flesh whitish, tinged with yellow, firm, fine-grained, melting, juicy, rich, sweet, very good; season, October to early November.

PEACHES

Arp Beauty is the earliest good yellow peach. This is the chief reason for its cultivation though it has other good characters beside earliness to give it a place among yellow peaches. At this Station the trees are healthy, vigorous, productive and hardier in bud than the average, its buds having withstood the cold of the test winter of 1911–12. The round-oval shape and shallow suture give it a pleasing appearance of rotundity. To its shapeliness, add a skin creamy and yellow with a heavy blush of red and covered with short, thick, pubescence with the sheen of velvet, and you have a beautiful peach. The flesh is light yellow, firm, juicy, sweet, rich, and of excellent quality, but unfortunately clings rather tenaciously to the stone. The season of Arp Beauty is from a month to five weeks earlier than Elberta and for so early a peach is remarkably long. We do not know from experience how the fruit will ship but believe it will stand the wear and tear of transportation and markets as well as any of the standard peaches. It ought to be in every home orchard.

Arp Beauty was introduced by Stark Brothers, Louisiana, Missouri, but we are unable to ascertain its origin.

Tree above medium to large, spreading, hardy, productive; leaves folded upward, oval to obovate-lanceolate, large, thin; upper surface dark green; lower surface silvery-green; season of bloom early, long. Fruit early, season long; two inches long, over two inches through, roundish-oval, slightly compressed, halves unequal; cavity deep and wide, abrupt; suture shallow, deeper at cavity; apex roundish, depressed; color greenish-yellow changing into a deep yellow, with a heavy blush of red; pubescence short, thick; dots large, conspicuous; skin thick, tough, adherent; flesh light yellow with faint red at pit, tender, melting, fibrous, juicy, rich, sweet; very good; stone clinging.

Frances.— The great desideratum of New York peach-growers is a good market variety to follow Elberta. Of a score or more, good, bad and indifferent, advertised to fill this particular niche in peach-growing, Frances is the best on our grounds. The trees are vigorous and productive and the buds withstood the winter of 1911–12, the severest winter in a quarter-century, better than did Elberta. The fruits average as large as those of Elberta — or, at most, fall short of it but a trifle. If anything it is more handsome than Elberta having a richer background of yellow and more brilliancy in its red cheek, more nearly round and more uniform in size and shape, seeming to have been cast in a rather more beautiful mold. Its quality is much the same as that of Elberta, the difference in flavor, texture, juiciness and all that go to make peaches palatable being in favor of Frances — though higher quality could be desired. But its chief right to a place in New York pomology arises from the fact that it extends the Elberta season a few days or a week. While it is quite as good a market peach as the Elberta on our grounds it can hardly be hoped that it has in equal degree the quality

that makes Elberta the greatest of all peaches —wonderful adaptability to all peach environments.

Frances came from Texas twelve or fifteen years ago. As to its history further than that we are not as yet informed.

Tree very large, tall, upright, slightly spreading, hardy, productive. Leaves folded upward oval to obovate-lanceolate, large, thin, and leathery; upper surface dark green; lower surface silvery-green; season of bloom intermediate, short. Fruit late, season long; two and three-fourths inches long, two and one-half inches through, roundish-oval, slightly oblique, halves unequal, bulged at apex; cavity medium in depth and width, slightly flaring; suture shallow, deepening toward apex; apex roundish; color deep lemon-yellow, specked and widely splashed dull red on a lively blush cheek; dots small, numerous, rather conspicuous; pubescence short, thin; skin thin, tough, separating readily; flesh yellow, red at stone, juicy, moderately coarse, tender, fibrous, pleasing subacid, rich, sweet, vinous; good to very good; stone free.

Miss Lola is a popular peach in parts of the South but is hardly known in New York. On our grounds it is the best of its season and one of the best of all peaches. Moreover, it fills a gap in the peach procession that ought to make it valuable in this State. It follows Mamie Ross and Greensboro, both of which it surpasses in appearance and quality. It precedes Champion and is even better than that handsome and delicious peach, and, quite as important, is almost a freestone while Champion is an out-and-out clingstone. Since it ripens with the well known Carman, fruit-growers will want to know how it compares with that variety. It is hardier in bud than Carman, that sort not having a single fruit after the cold winter of 1911–12 while Miss Lola bore a fair crop; it is of better quality, a little larger, hardly as well colored and on our grounds is more productive.

Miss Lola was grown by J. W. Stubenrauch, Mexia, Texas, from a pit planted in 1876.

Tree large, vigorous, upright-spreading, open-topped, hardy, productive; leaves nearly flat, large; upper surface dull dark green, smooth; lower surface silvery-green; season of bloom early, long. Fruit mid-season, season long; two and three-eighths inches long, two and one-half inches wide, two and one-half inches broad, oval, often roundish-oval, usually somewhat oblique, slightly compressed, halves nearly equal; cavity deep, wide, abrupt; suture shallow, deepening toward apex; apex roundish, slightly depressed, mucronate; color creamy-white, specked and blushed with carmine, with darker splashes, overspread with short pubescence; dots inconspicuous; stem short; skin thin, tough, separating readily; flesh white, red at pit, fine, melting, fibrous, sweet, sprightly; very good; stone nearly free.

PLUMS.

Imperial Epineuse is one of the most promising plums grown on our grounds — it is not surpassed in quality by any other purple plum. Moreover, it is one of the largest in the prune group and one of the most attractive by reason of its well molded form and its handsome reddish-purple color which is lighter or darker according to the exposure of the plums to the sun. There are but two trees of this variety on the Station grounds but there are a number

of them in each of two orchards near Geneva and in both the fruit qualities are the same as on the two trees at the Station. Wherever we have seen this variety the tree characters are exceptionally good; the plums are borne on main limbs and are thus protected from the sun; and the trees are large, vigorous and hardy. A striking character of the variety is its strong, upright growth. In watching the behavior of the Imperial Epineuse for several years, we have become convinced that it is a desirable market plum for New York.

Imperial Epineuse was found as a chance seedling about 1870 in an abandoned monastery near Clairac in the Valley of Lot, the great prune district of France. It was brought to the United States by Felix Gillett of Nevada City, California, in 1883, who offered it for sale under the name "Clairac Mammoth" in 1893. In 1895 E. Smith & Son of Geneva, N. Y., received the variety from Mr. Gillett but grew it under the name of "Clarice Mammoth." The trees on the Station grounds were obtained from E. Smith & Sons, Geneva, N. Y., in the spring of 1897.

Tree large, vigorous, spreading, productive; branches numerous, with many fruit-spurs; leaves obovate, thick, rugose; blooming season intermediate in time and length; flowers appearing after the leaves, one inch across, borne singly or in threes. Fruit late, season short to medium; large, slightly obovate, purplish-red, darker on the sunny side, mottled, overspread with thick bloom; flesh greenish-yellow, tender, sweet, very agreeable in flavor; good to very good; stone clinging.

Middleburg is so remarkable in several qualities that the wonder is that it has so long escaped the attention of plum-growers. The name is not mentioned in any pomological textbook though the plum has probably been in existence three-quarters of a century. Accounts of it in horticultural and station reports are scant and fragmentary and none do it justice, though in "*The Plums of New York*," published by this Station, an effort was made to bring it prominently before fruit-growers.

Middleburg is surpassed in appearance by a number of plums, but few of its color and season are better in quality either for dessert or for cooking. It ripens as one of the last with several other good sorts, none of which surpasses it in several respects; as, in hanging to the tree, in long keeping, and in freedom from black-knot and brown rot. Out of a collection of about three hundred sorts on the Station grounds, Middleburg and Palatine are freest from black-knot and Middleburg is probably freer than any other Domestica plum from brown rot. The trees are of only medium size but are robust, healthy, hardy and productive. With special care they might be made to grow larger plums. It is certain that Middleburg ought to be in every collection for home orchards and it is probable that it can be grown profitably for the markets. Both tree and fruit are at first a little disappointing but both improve upon acquaintance. Nurserymen do not generally offer this variety for sale. But once plum-growers know its value a profitable demand is sure to spring up for it.

TENNANT

The variety is named from Middleburg, Schoharie County, New York, where it is said to have been found many years ago as a chance seedling. Mr. S. D. Willard, the veteran plum-grower of Geneva, N. Y., whose recent death all lament, has the credit of first calling attention to Middleburg. In 1886 he mentioned its good qualities at the meeting of the Western New York Horticultural Society.

Tree above medium in size, vigorous, round and open-topped, hardy, productive; leaves oval, rather thick, dark green; blooming season early to medium, short; flowers appearing after the leaves, one inch across, white, borne singly or in pairs. Fruit very late, season long; one and five-eighths inches by one and one-half inches in size, distinctly oval, varies in color from light to deep purplish-red, overspread with thick bloom; dots numerous, inconspicuous; stem one inch long, adhering well to the fruit; flesh light yellow, rather juicy, firm, sprightly when first mature, becoming sweetish, strongly aromatic, pleasant flavor; very good; stone semi-free or free.

Pearl.— The rich, golden color, large size, fine form, melting flesh and sweet, luscious flavor, give Pearl a place among the best dessert plums. In the Station collection of this fruit, it is surpassed in quality by no other variety. Unfortunately, the tree characters are not as good as the fruit characters. The trees are vigorous, healthy, seemingly hardy and attain fair size, but in the decade they have been fruiting at this Station they have not borne large crops. On other soils or under different environment, if the defect of unproductiveness can be overcome, Pearl becomes at once a plum of great value. In California it is said that this variety makes delicious prunes, a statement which no one will doubt who has eaten the fresh fruits. How the variety will stand shipment to large markets remains to be seen. We should say that it could be as well shipped as Reine Claude. It can certainly be profitably grown for local markets and can be most highly recommended to all who grow fruit for pleasure. Nurserymen do not commonly include it in their catalogues but it is hoped that the prominence given it here and in "*The Plums of New York*" will induce some to do so.

Pearl is one of Luther Burbank's early introductions but seems not to have had the advertising that some far less worthy plums have had. It was catalogued by Burbank in 1898 and received by this Station in the spring of the same year. One parent is given by the originator as the well-known Agen so popularly grown in California. Burbank does not state what the male parent was but from the fruit and tree, it may be assumed that the pollen came from some variety of the Reine Claude group. Were it not for the statement of the originator, no one would suspect it to be an offspring of Agen, but the veriest tyro in plum-breeding would put it down as a relative of Reine Claude.

Tree of medium size, vigorous, vasiform, dense-topped, hardy, not very productive; leaves broadly oval, thick, leathery, dark green; blooming season intermediate in time and length; flowers appearing after the leaves, showy on account of their size,

averaging one and five-eighths inches across, usually borne singly. Fruit ripening in mid-season; one and three-fourths inches by one and one-half inches in size, roundish-oval, compressed, golden-yellow obscurely striped and splashed with dull red, overspread with thin bloom; dots numerous, whitish, inconspicuous; flesh deep yellow, juicy, firm but tender, very sweet, with a pleasant, mild flavor, aromatic; very good to best; stone clinging.

Tennant has been grown and esteemed in the Pacific Northwest for twenty years but seems not to have found a place in New York. Indeed, so far as can be learned, it has hardly been tried in New York. In the plum collection on the Station grounds this variety is prominent in size, beauty of form and in color. Unfortunately, it is not of sufficiently high quality to be called a first rate dessert fruit and yet it may be rated as far above the average in quality and as well toward the top among purple plums. It ripens a few days before the well known Italian or Fellenburg prune and in the Pacific Northwest is said to ship and keep well — two qualities which it would maintain in New York if we may judge from its skin and the firmness of its flesh. In some seasons the plums have the serious defect of shrivelling a little after ripening. The Tennant plum tree is ideal — large, vigorous, healthy, hardy and productive, unexcelled in tree characters by any other variety. Tennant should be very generally tried in commercial plantations in New York and there should be a few trees in every home orchard.

This plum originated with Rev. John Tennant of Ferndale, Washington, and was introduced in 1893 by McGill & McDonald of Salem, Oregon. It is listed by a few eastern nurserymen and can be had from any western grower of plum trees.

Tree large, vigorous, round-topped, open, hardy, productive; leaves oval or obovate, thick, dark green; blooming season early, short; flowers appearing after the leaves, borne on lateral spurs. Fruit ripening in mid-season; one and three-fourths inches by one and five-eighths inches in size, roundish-truncate or roundish-oblong with irregular surface which is somewhat ridged; color dark reddish-purple, overspread with thick bloom; dots numerous, conspicuous; flesh dark golden yellow, somewhat dry, coarse, firm, sweet, mild but pleasant; of good quality; stone clinging.

CHERRY.

Schmidt, shortened in accordance with the rules of the American Pomological Society from Schmidt's Bigarreau, is not new nor can it be said to be little known, since it has been rather widely planted in America for a score of years. Yet in New York, at least, it is not receiving the attention that it deserves from commercial cherry-growers being relegated to the rear of ten or a dozen kinds when it should be in the front rank. Indeed, about Geneva, where many sweet cherries are grown, while not the leading, it is one of the best market varieties. The characters which entitle it to first place as a money-maker are: largeness, being unsurpassed in size by any other black cherry in this region; its round, plump, form and glossy black color which tempt the eye; crisp, firm, juicy flesh and sweet,

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rich flavor, delicious to the taste; dark ruby-red color under the skin which makes it as pleasing inwardly as outwardly; freedom from brown-rot, in this respect excelling any other market sort; and a vigorous, healthy, productive tree. There is a good deal of enthusiasm in New York over several new sweet cherries from the Pacific Coast but in this vicinity none of these is equal to the Schmidt.

Schmidt, as the name implies, is of German origin having been grown from a pit in that country about 1850. It was introduced into England about 1870 from whence it came to America about thirty years ago.

Tree large, vigorous, upright-spreading, open-topped, productive; trunk and branches stocky, rather smooth; leaves large, light green; season of bloom intermediate; flowers borne in scattering, well distributed clusters in twos and in threes. Fruit matures in midseason; nearly an inch in either diameter, cordate; color purplish-black; stem slender, strongly adherent to the fruit; skin tough; flesh purplish-red, with dark colored juice, very meaty, crisp, firm, mild, sweet; of very good quality; stone semi-clinging.

GRAPES.

Berckmans is not receiving the attention in this State that it deserves. To those who have not seen the variety, it may be said that the fruit is like that of Delaware and the vine like the Clinton, these two sorts being its parents. In quality it is not quite as good as the Delaware but it does not fall far short of the last-named sort in tenderness, sweetness and richness. The fruit keeps and ships better than does that of its well known parent. It is in vine characters, however, that Berckmans surpasses Delaware, being much more hardy and vigorous, less subject to mildew and well suited to more kinds of soil but having the fault of not coloring well in an environment to which it is not adapted. Berckmans has been grown as an amateur's grape for forty-five years The popular verdict seems to decree that it must remain a grape for the amateur, but from its behavior on these grounds it would seem certain that it has value in commercial plantations wherever the Delaware is grown and, in particular, as a grape for local markets.

Berckmans was produced by Dr. A. P. Wiley of Chester, South Carolina, from Delaware seed fertilized by Clinton.

Vine vigorous, hardy, productive; canes long, slender; nodes prominent. with short internodes; leaf-buds open very early; leaves rather small, light green; flowers open early, fertile. Fruit ripens with Delaware, keeps unusually well; clusters resemble Delaware in shape and size but are longer and more often shouldered; berries slightly larger than Delaware, roundish to slightly oval, somewhat darker than Delaware when well ripened, persistent, firm; flesh tender, inclined to melting, vinous, sweet to agreeably tart, sprightly; very good in quality; seeds separate easily from the pulp, average three, below medium in size.

Delago is another offspring of Delaware, the male parent in this case being Goethe. Delago, too, is an old sort almost passing from cultivation, which should be retained for two qualities at least. It is one of the latest-keeping grapes on our grounds out of a col-

lection of between four and five hundred. Again, it is the firmest-fleshed of all our American grapes and in this respect comes as near being a European as any other. The quality, while not of the very best, is still very good, falling short in being a little too tart and not quite rich enough. The bunches and berries are intermediate in size and color between Delaware and Goethe. The fruit ripens late and the variety ought not to be planted where the Catawba cannot be grown. A careful study of the needs of this variety would probably show that with special treatment a splendid late-keeping grape might be grown for the fancy market. Certainly it is worth cultivation by every amateur who wants grapes in midwinter.

Delago was produced by the late T. V. Munson as long ago as 1883 but seems not to have impressed him favorably as he did not introduce it until 1896. The variety came to this Station in 1897 and has fruited regularly since 1900 but it does not always ripen on our grounds and we had not seen it at its best when "*The Grapes of New York*" was published and it did not, therefore, receive the attention in that work that we should give it were we now publishing.

Vine medium in growth and productiveness, not always hardy, somewhat susceptible to mildew under unfavorable conditions; canes rather long, numerous, of medium size; nodes slightly enlarged, with short internodes; leaves of medium size, light green; flowers open in midseason or later, sterile. Fruit matures late, keeps unusually well; clusters medium in size, oval in outline, variable in compactness; berries medium to large, roundish, dark red, very persistent, meaty, vinous, sweet; very good in quality; seeds slightly adherent to the pulp, average two, large.

Eclipse is the only new grape in a collection of over four hundred that we can unqualifiedly recommend fruit-growers to test. We have had it at this Station since 1893 and it has been fruiting since 1896 and each year obtains greater favor in the eyes of those who see it. It is a seedling of Niagara and, therefore, a grandchild of Concord, which it resembles, differing chiefly in being earlier and of much better quality. Unfortunately, the bunches and berries are just a little smaller than Concord. The vines are hardly surpassed by those of any other variety, being hardy, healthy and productive — qualities that should commend it for commercial vineyards. The ripe fruit hangs on the vines for some time without deterioration and the grapes do not crack in wet weather. It ripens several days earlier than Concord and should make a splendid forerunner of that standard sort.

Eclipse was originated by E. A. Riehl of Alton, Ill., from seed planted about 1890. The mother plant was Niagara; the pollen parent is not known. The variety was introduced in 1906 by Stark Bros., Louisiana, Missouri.

Vine vigorous, hardy, productive; canes intermediate in length, number and size; nodes slightly enlarged, with internodes of average length; leaf-buds open in mid-

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season; leaves rather large, dark green; flowers sterile, open in mid-season. Fruit ripens a little earlier than Concord, keeps fairly well; clusters intermediate in size and length, frequently single-shouldered, compact; berries large to medium, oval, dull black, covered with abundant bloom, persistent, firm; flesh tender, juicy, sweet next to the skin, agreeably tart at the center; resembles Concord closely in flavor; good in quality; seeds separate very easily from the pulp, average two or three, of medium size.

Secretary is an old grape now scarcely grown but one which we never lose an opportunity of recommending and shall continue to recommend until it is found in the vineyards of not only amateurs but of some commercial growers in New York. Few grapes have more good characters to commend it: thus, it is of exceptionally high quality; the berries are firm, meaty and yet juicy, fine-grained and tender, with a sweet, spicy, vinous flavor; the bunches are large, well formed, of medium size and composed of purplish-black berries covered with thick bloom which make a most handsome fruit. Unfortunately, the vine characters are not as good as those of the fruit. It lacks a little in hardiness, vigor, productiveness and in health, being injured by mildew and black-rot to a considerable extent. These defects have kept the variety from taking a place of commercial importance in New York, since the grape can be grown well only in favored localities and with somewhat special care. Yet, despite these defects, Secretary has so many good qualities that we strongly recommend its culture to both amateurs and those who are willing to give special attention in producing a fancy market grape.

Secretary is the result of a cross of Clinton by Muscat Hamburg — the first a native grape, the other a European. The cross was grown by J. H. Ricketts, the noted grape breeder, of Newburgh, New York, as long ago as in 1867. On account of its several weaknesses it has not been popular and is offered for sale by few nurserymen. Vines can be obtained, however, from a number of amateur growers and a stock could rapidly be built up, should demand arise for it, as we hope it will.

Vine a little lacking in vigor, and in hardiness; variable in productiveness, somewhat subject to attacks of fungi; canes short, of medium thickness, light brown but conspicuously darker at the nodes, the surface covered with thick, blue bloom; leaves small, thin, light green; flowers semi-fertile, open early. Fruit ripens soon after Concord, keeps and ships well; clusters large and long, frequently with a large, single shoulder, variable in compactness but often loose and, unless cross-pollinated, with many abortive fruits; berries large, roundish to oval, somewhat flattened at the point of attachment to the pedicel, dark purplish-black, covered with thick bloom, persistent, firm; flesh juicy, tender, vinous, sweet; of good quality; seeds separate readily from the pulp, large.

RASPBERRIES

June has been tested long enough in different parts of New York to fully determine its value. Reports received indicate that it is quite equal and often superior to the best older varieties. It is

worthy of extensive planting on account of several remarkable characteristics of both plant and fruit. The plants are as hardy and as healthy as those of its two well known parents, Loudon and Marlboro, and are more vigorous. But comparatively few suckers are produced and these are little crowded and are thus better able to mature their crop. The yield is heavy and is well distributed over a long season, which begins the earliest of any of the 70 varieties growing at this Station — ripening as no other raspberry does, in June, hence the name. The fruit resembles Loudon in color, a bright, handsome red and averages larger than Cuthbert but is more spherical. June ships and holds up in size unusually well throughout the season. Last, but by no means least, June is high in quality. We expect to see this variety become one of the most profitable red raspberries grown.

June is the result of a cross made on the Station grounds in 1897 between Loudon and Marlboro. From this seed, 338 plants were secured, one of which, after fruiting for several years, was named "June" and in 1909 was disseminated among raspberry growers.

Plants more vigorous than either of its parents, upright, few suckers, hardy, very productive healthy; canes stocky, nearly smooth, roundish, often with considerable bloom; spines straight, of medium thickness, short, few in number and distributed almost entirely near the base; season of bloom June 2 to June 9 in 1912. Fruit matures very early (June 28 to July 16 in 1912), season long, keeps and ships well, adheres well to the bushes, easily picked; berries very large, and holding their size unusually well until the close of the fruiting season, firm, with large drupelets, bright, handsome red resembling Loudon, mild subacid; of good flavor.

Plum Farmer makes the best showing of any black raspberry on the Station grounds. Black raspberries have more than their share of diseases and other troubles, and plantations of this fruit must be frequently renewed. How long a new variety, as Plum Farmer, will continue to make high record is hard to tell, since its present behavior may be in some degree a first flush of vigor. The Station plants were set in 1909 and are not old enough to enable one to determine how well they will withstand the vicissitudes to which this fruit is subject. Reports from other regions where the variety has been grown longer indicate that the variety holds up well and that it has come to stay as a commercial sort. The plants are vigorous, healthy, and were little injured here by the unusually severe winter of 1911–12. Perhaps the chief value of Plum Farmer lies in its season, which is early, ripening a week or more in advance of Gregg. The fruit is large, about the size of Gregg, of good color, high quality and ships well — all in all, a splendid new fruit, well worth testing.

Just where this variety originated and what its parents are will probably never be known. The first plant was found by L. J. Farmer, Pulaski, New York, in a shipment of some other variety received by him from Ohio about 1892. This plant quickly

attracted his attention and he began its introduction in a small way as early as 1895.

Plants vigorous, upright, dense, hardy, very productive, healthy; canes stocky, long, numerous, roundish, bright red, heavily overspread with dense bloom; prickles large and long, thick, strong, straight, sharp, medium in number; branches thick, long, numerous, reddish, densely coated with bloom, with internodes of medium length; season of bloom June 2–9 in 1912. Fruit matures early, season of ripening July 8–19 in 1912, easily picked, ships well, one of the best to withstand seasons of severe drought; berries large, well-colored but not glossy, very black, covered with bloom, firm, uniform, sprightly at first becoming mild at full maturity, juicy; of good quality.

CURRANTS

The **Perfection** currant has already assumed commercial importance in New York showing that its good qualities are known. But the variety does so well at Geneva that we feel that all small-fruit-growers should know it. Plants were set at the Station in 1897 and, ever since, the variety has found favor with currant-growers. In form of bush and in health and vigor, the Perfection is intermediate between its parents, Fay and White Grape. The fruit is borne along the old wood much like that of the White Grape. In both size of cluster and berry, it excels Fay. The fruit is uniformly large to the tip of the cluster, the stem of which is free from berries near its attachment to the plant, thus making it easy to pick. In color the fruit is an attractive red, slightly lighter than the Fay, and the variety is superior to Fay or Cherry in flavor and quality.

Perfection was originated by Charles G. Hooker, Rochester, New York, in the spring of 1887, by crossing White Grape and Fay. The new variety was introduced by Messrs. C. M. Hooker & Sons, Rochester, New York, in 1902.

Plants large, vigorous, upright-spreading, hardy, productive, healthy; branches stocky, smooth, long, straight, numerous, brownish, dull and with little red; foliage deep green, healthy; season of bloom May 6–10 in 1912. Fruit matures in midseason — about with Fay and Cherry — July 1–8 in 1912, very easily picked, ships well; clusters long, compact, cylindrical, slightly tapering; stems long, of medium thickness; pedicels short, thick; berries roundish, uniformly large, cling well to the pedicels, bright handsome red; skin thin but tough; flesh juicy, tender, sprightly subacid, of good quality; seeds intermediate in size and number.

The **Diploma** currant is well worth planting in the currant growing sections of this State. It is a light red currant, lighter than either Fay or Cherry, with long clusters and an upright habit of bush. The plants have uniformly been productive, not equal, however, to Wilder in this respect, although as vigorous as that variety. The fruit is more transparent than any other red currant — a marked characteristic of the variety. The segments are unusually distinct as are also the seeds which show plainly through the thin skin. The flavor of Diploma is mild, although not so sweet as in some — Ruby, for example. It appears to be juicier than most currants and on this account must be handled with care, but when picked and packed properly will doubtless ship in good condition long distances.

The variety was originated by the late Jacob Moore of Brighton, New York, from seeds of Cherry crossed with White Grape sown in 1885. Mr. Charles A. Green, Rochester, New York, secured control of the stock and introduced it in 1906.

Plants large, vigorous, upright-spreading, dense, hardy, productive, healthy; canes numerous, stocky, of medium smoothness, long, somewhat angular, reddish-brown; season of bloom May 8–12 in 1912. Fruit matures in mid-season, period of ripening July 3–11 in 1912, easily picked; clusters medium to above in length; stems rather short, medium in thickness; pedicels of average length and thickness; berries large, roundish, adhere tenaciously to the pedicels, bright, but light, red which changes but slowly after picking; skin very thin, medium in toughness, very transparent, the segments, veins and seeds unusually distinct; flesh semi-transparent, tinged with red, yet tender, very juicy, sprightly subacid becoming mild as the season advances; good to very good in quality; seeds numerous, large, attracting attention on account of the transparent skin and flesh.

GOOSEBERRY.

Poorman.— There is a revival of interest in gooseberries in New York. Even so, there are fewer varieties grown than of any of the other small fruits and there is probably greater room for improvement in the character of the kinds. Of the European gooseberries, Industry now leads while Downing is the favorite of the American varieties. There is, however, a variety which, while not new, is untried in New York except at the Station, and which if it thrive elsewhere as here is most promising for commercial plantations. The variety is the Poorman which has borne fruit on the Station grounds for the past three seasons. It at once attracts attention on account of the vigor and productiveness of the bushes and the handsome appearance and high quality of the fruit. Plants and berries of Poorman give it a place as leader among the 62 kinds in the Station plantation. The past season, one bush yielded 7 pounds 8 ounces and another 7 pounds and 15 ounces of fruit. The vigor of the variety is such that the plants must be set farther apart than with most kinds. The berries are larger than those of the common American sorts, Houghton and Downing, and are more oval and as full maturity is reached more red develops than in Houghton. The quality is excellent.

The variety originated about 25 years ago with William H. Craighead, Brigham City, Utah, and was introduced in the fall of 1896 by Mr. D. S. Lohr, Tremonton, Utah. It is said to be a cross of Houghton and Downing and the habit of bush and character of fruit would indicate such parentage. It is also stated that the seed from which this plant was produced was brought from Denmark by a Danish woman from whom Mr. Craighead procured the seed — hardly creditable from the appearance of the plants.

Plants large, vigorous, upright-spreading, dense, hardy, very productive, not susceptible to mildew; branches rather stocky, rough, long, usually straight, resembling Downing more than Houghton; spines thick, strong, long, less numerous and thicker

PROLIFIC

than those of Houghton, variable in number; foliage healthy; season of bloom May 7-11 in 1912. Fruit matured July 8-17 in 1912, period of ripening long, readily picked, ships well; berries over an inch long, nearly an inch through, oval to slightly obovate, semi-transparent, silvery-green changing at full maturity to pinkish-red; of good quality.

STRAWBERRIES.

Prolific is a Station seedling strawberry which has already attracted the attention of strawberry growers, and is considered by many so desirable a commercial variety that it is being planted extensively. Its greatest fault is a tendency under unfavorable weather conditions to be affected by leaf spot. This, however, may be controlled by spraying with bordeaux. The plants increase rapidly and are as vigorous as those of either of its two well-known parents, Sample and Marshall. The blossoms are perfect. The plants have yielded at the rate of 14,502 quarts per acre; the fruit matures in mid-season and the large, firm, well-colored and well-shaped berries are produced in great numbers, holding up in size unusually well throughout the season. In color, Prolific resembles Sample rather than Marshall. The flesh is pleasantly acid, and of good flavor and color, slightly lighter in color than Marshall. On account of the vigor and productiveness of the plants and the attractiveness of the large, uniform, well-colored berries, Prolific is well worthy of commercial planting.

Prolific was the result of pollen of Marshall on the flowers of Sample. Seed of this cross was secured and sown in the spring of 1899 and resulted in the development of seedlings, the most promising of which was the variety under discussion. It was distributed among many strawberry growers in the spring of 1908.

Plants numerous, vigorous, very productive, somewhat susceptible to leaf spot; leaves large, wide, of medium thickness, medium to dark green; leaf-stalks long, thick; fruit-stems of medium length, stout, usually single, semi-erect; flowers perfect, intermediate in time of bloom; calyx medium to below in size, depressed, not leafy; seeds numerous, somewhat raised. Fruit matures in mid-season, ripening period long, easily picked; berries very large, retain size well as season advances, roundish-conic to blunt wedge, not necked, with blunt apex, handsome bright scarlet; flesh firm, well colored at the center, juicy, pleasantly acid, aromatic; of good quality.

Chesapeake is described in this bulletin as one of the most promising of the comparatively new strawberries. It has several distinctive characters, chief of which are the vigor and healthfulness of the plants and the beauty and attractiveness of the fruit. The plants do not multiply as rapidly as most varieties and should on this account be set somewhat closer. There is but little danger of frost on account of the habit of late blooming, a most valuable consideration in some localities. Chesapeake ripens just before Gandy. The large, leafy calyx is well-colored and adds to the attractiveness of the fruit. The appearance of the surface of the berries is characteristic of the variety. The outline is unbroken by furrows or irregularities in the surface

which is unusually plump and glossy, and in which and on which are thickly scattered the seeds. On this account the smaller berries often have a somewhat seedy appearance. The most valuable asset is high quality in which it is hardly surpassed. The dark red flesh is aromatic, highly flavored, mildly acid and is very good to best in quality. Among the many varieties tested on the Station grounds, Chesapeake stands among a few kinds at the top.

This variety was originated by J. W. Parks, Nanticoke, Md., about 1904 and was introduced by W. F. Allen, Salisbury, Md., in 1906. Its parentage is unknown. It is unfortunate that in some sections plants not true to name are being sent out for this variety.

Plants rather few, vigorous, usually healthy but with a tendency to mildew, productive; leaves above medium in size, wide, thick, dark green; leaf-stalks long, thick; fruit-stems intermediate in length, thick, usually branched, semi-erect; flowers perfect, season of bloom late; calyx large, leafy, attractive green, slightly depressed; seeds conspicuous often markedly raised, numerous. Fruit matures in mid-season or later, ripening period of medium length, easily picked, ships well; berries large, dropping in size as the season advances, roundish-conic to wedge-shaped, the surface plump, unbroken by furrows or by irregularities, not necked, with conical apex which becomes seedy in appearance in the smallest berries, beautiful glossy scarlet; flesh very firm, somewhat variable in color, mildly acid, juicy, pleasant flavor; good to very good in quality.

THE SETTING AND DROPPING OF FRUITS.*

U. P. HEDRICK.

One of the discouragements in fruit growing is the uncertainty which attends the formation and development of fruit buds. Failure to set fruit even though the trees bear an abundance of blossoms, the dropping of immature fruits, the biennial bearing habit of certain apples and unfavorable weather at blooming time, are common and seemingly unpreventable drawbacks to profitable fruit growing. The Biblical injunction "to dig about and dung the trees" may be obeyed both literally and figuratively and yet the trees may fail to blossom, or to set a crop, or the fruit drops, or wind, rain, cold or frost may destroy the embryonic fruits. Indeed, seemingly, the better the culture, the greater the retrogression in sexual reproduction, and the forces set in motion by the cultivator in no way nullify the effects of bad weather.

Roughly the above problems fall under two heads: First, those having to do with the formation of fruit buds; second, those having to do with the development of the buds.

Can the fruit grower influence the formation of buds? Though he cannot wholly control the formation of buds, he can at least greatly influence their formation. We may lay down as the first principle having to do with the formation of fruit buds, one founded on the experience of fruit growers with practically every fruit: that plants develop fruit buds only where there is a store of food materials in twigs and branches. Another statement to much the same effect is that plants will not form fruit buds when the food material is being largely used in the production of new wood and new leaves.

Many facts and horticultural practices substantiate the statements just made. Thus, trees unduly luxuriant in growth do not set fruit; plants without sufficient food for both wood and fruit bearing do not as a rule produce fruit; in warm, damp climates trees and vines grow to great size and with much foliage but bear little or no fruit; pruning, which is favorable to wood growth, is

* Reprint of Circular No. 22.

antagonistic to fruit production. Plants that are producing too much wood and foliage and too little fruit may be subjected to several treatments to induce them to bear fruit.

Regulation of the water supply sometimes induces the formation of fruit buds. In the irrigated regions of the west, vegetative growth may be stopped by withholding water and the setting of fruit buds thus be materially influenced. It is a matter of common observation everywhere that a dry season is more conducive to the formation of fruit buds for the ensuing season's crop than a wet one. The water supply in unirrigated regions may be regulated only through drainage, but fortunately drainage may often be made an important means of inducing early fruitfulness and a fruit-bearing habit. Other things being equal, trees on wet, sodden soils do not bear fruit early in life and do not set fruit regularly and in proper quantities. Under such conditions there is insufficient food for either wood or fruit production. The remedy is obvious and the subject needs no further discussion.

Much can be done in securing the proper formation of fruit buds by giving the trees an abundance of light. The outside row in an orchard, where the trees have most light, usually bears the most fruit. It is true that these isolated trees have more food and moisture as well as more light and because of these two factors, also, many buds set. Yet light must be counted as important and is to be secured by proper spacing and by developing open-headed, well pruned trees.

The food supply has much to do with the formation of fruit buds and probably the most rational procedure under average orchard conditions to induce fruit bearing is to regulate the supply of food. With the widely varying conditions of different orchards, this is not easily done. It does not appear from any information that we now have that there is a storage of particular food for fruit buds and of other food for wood growth but rather that stored food is quite as available for one sort of growth as for the other, yet it is generally supposed that the kind of food given plants influences the amount stored, and consequently, the number of fruit buds formed or the amount of growth made.

Briefly, the behavior of foods upon manner of plant growth is supposed to be this: An abundance of food, especially if it contains nitrogen, and if at the same time there be a plentiful supply of water, is most favorable to the formation and growth of cells, hence of wood and leaf growth. If the amount of food be

decreased, and more particularly if the nitrogen as compared with the potash and phosphate be decreased, and especially if there be an increase of light and air, wood growth is lessened and the number of fruit buds is materially increased.

Sometimes the excess of food and moisture is already in the soil and the problem then is to reduce the quantities and so bring on fruit-bud formation. The orthodox method of reducing the quantity of plant food and soil moisture is to sow a grain crop in the orchard. The trees under such treatment cease to make wood growth and use the assimilated substances in the making of fruit buds. This procedure, it should be said at once, is seldom necessary.

The fact that leaf and wood growth and fruit bearing in plants are opposed to each other is well recognized by fruit growers; but the knowledge is quite too often wrongly used, exemplifying again that "a little learning is a dangerous thing." Thus, to bring trees into bearing is often the owner's excuse for double-cropping orchards, putting an orchard down to sod and withholding proper cultivation.

Pruning often materially aids in causing the storing of plant food for the formation of fruit buds. One of the general aims of pruning is to regulate the crop of fruit by removing parts of the plant that those remaining may store the necessary food. The theory of pruning to cause formation of fruit buds is simple but the practice is not so simple. The effects of pruning are so varied under different conditions that it is exceedingly difficult to give directions as to its use in influencing the setting of buds.

Heading-in may sometimes be used to advantage in pruning for fruit. It consists in cutting back young, unbranching shoots which set few or no fruit buds. Heading-in is a necessity with dwarf trees. Practice differs as to whether the operation should be performed in summer or winter but it is usually performed in summer and is then spoken of as summer pruning. Heading-in greatly thickens the top, thereby excluding light and must be practiced very judiciously or more harm than good is done.

Summer pruning is rather commonly used to influence the formation of fruit buds for the succeeding season. The theory is that by removing a part of the young shoots of the current season, we take from the trees the portions which are making the greatest demands on the plant's nutritive powers and that the remaining parts of the shoots with their buds are enabled to

store up greater quantities of reserve food than they otherwise could. This summer heading-in should be done before growth ceases. So much, however, depends upon several varying factors that no fixed rule can be given as to time; thus, much depends upon the fruit, the varieties, soil, climate, weather and the amount of growth.

Summer pruning is a weakening process and may permanently injure a tree in our climate. With standard trees it is only of advantage in moderation in eastern North America and as usually practiced more often results in evil than in good. Summer pruning is of more value in the early life of the tree than later on. Summer pruning as means of inducing fruitfulness is greatly overestimated under American conditions and belongs more properly to the elaborate systems of pruning and training practiced by Europeans.

Those who do not find pruning a sufficiently drastic method of checking wood growth to augment fruitfulness, may resort to the removal of a ring of bark from the trunk of the tree. In rather extensive experience on the grounds of this Station, we have found ringing of some use with the apple. Our practice is to remove a ring of bark from one-half to one inch wide from young apple trees at the period when the trees are making the greatest growth, usually about the middle of June. If the ringing is done earlier in the season or later in the season than June, injury is certain to result. Should it be done when the growth is being checked by drought, injury would also result.

The theory upon which ringing is based is simple. Crude sap passes from the roots to the leaves through the outer layer of wood. In the leaves this crude material is acted upon by various agencies and transformed into food substances. This accumulated material passes downward through the inner bark to be distributed throughout the plant where needed. When trees are ringed the flow of sap upward through the wood continues as before the operation but the newly made food-substance can not pass below the girdle and, therefore, accumulates above and is used for the formation of fruit buds though at the expense of other parts of the plant.

Is heredity a factor in bud formation? Can the fruit-bearing habit be passed down from one tree generation to another? Can the habit be augmented and intensified by selection? Individuals in an orchard vary as to time of coming into bearing, regularity of bearing and number of buds formed in any season. But it has not been proved that buds chosen from the trees best in these

respects would produce trees that are early bearers, or more regular in bearing or more fruitful. The present trend of science is against such a possibility. Even were it possible, there are a number of practical drawbacks.

Thus, from tree generation to tree generation constitutes a period of time too long for most men to bend their efforts, especially with that clear conception of exactly what is wanted that is required in the intricate problem of plant selection. The variations at best are but slight and hundreds of trees would have to be examined to find one or two from which to start a new race. One would have to make sure, too, that the selected plants would not fall behind their fellows in other characters. The variations mentioned are almost certainly the result of environment and are not passed on from one tree generation to another so that, even were the obstacles not so great in practicing selection that few men would be able, or would take the pains to surmount them, heredity could not be counted as a factor in causing the formation of buds.

Another phase of the subject of fruit-bud control is the biennial bearing habit of some varieties of the several fruits and especially of the apple. So marked is this habit in apples that we can ascribe it as one of the characters of that fruit. A good deal of attention has been given by orchardists and experimenters to biennial bearing in apples but as yet no one has been able greatly to change nature's way. It is maintained by some that the biennial bearing habit is due to the heavy crop which exhausts the tree's energies and that a light crop follows because of such exhaustion. This can be but partly true; for all can call to mind two, three, or four heavy crops of some varieties after which the trees settle down to bearing in alternate years.

Nor does thinning, often proposed as a remedy for over-bearing, prove of much value. Pruning seems to alter the condition but little. We have on record several experiments in which blossoms were stripped from the trees during the bearing year to cause the setting of fruit during the off year. The trees so treated usually bear some fruit the off year but seldom a satisfactory crop. Nor is the matter one of food supply. Orchards amply supplied with food are not always annual bearers. Peculiarities of the season have something to do with alternate bearing but do not wholly account for it. Eliminating all the above conditions — admitting, however, that all have some influence on the bearing habit — we must conclude that the biennial bearing habit of

apples is a peculiarity of the species. Good cultivation, an ample supply of food at all times, careful attention to pruning and training, proper control of pests and systematic thinning, are all means which can be used to some extent to circumvent Nature.

Leaving now the formation of fruit buds, let us see what can be done to control the development of fruit buds.

Blooming, the prelude of fruiting, had little significance to the fruit grower until the discovery was made that many varieties of several fruits were unable to fertilize themselves and that failures of fruit crops were often due to the planting of infertile varieties. The knowledge obtained by experimenters in this field has to some degree modified the planting of all orchard fruits. Pollination and fertilization are events which take place in blossoms that must be reckoned with by fruit growers.

It is necessary to distinguish between pollination and fertilization, terms supposed by many to have the same meaning. Pollination is the dusting of the stigma, the female organ of a flower, with pollen, the male element. Fertilization is the process in which the male cell unites with the female cell. Fertilization takes place only after pollination, but a flower may, of course, be pollinated and fertilization not take place, a fact always to be remembered. Fruits set and develop, for most part, only after fertilization. The young fruits when first formed have but a slight hold upon life. Unfavorable influences, no matter how slight, may cause them to perish. Fertilization gives the tiny fruit life, and enables it to hold upon the parent plant through nourishment drawn to supply the embryo which has been formed in the seeds. Thus fertilization usually, not always, determines whether a fruit is to develop or to drop. Shortly after blooming time, we have the fruit "drop," resulting for most part from a lack of fertilization.

But fertilization does not insure the complete development of fruit. Even after a perfect union of male and female cells, so far as it can be determined, much fruit drops in every orchard and without regard to whether the trees bear few or many blossoms.

Crops of many varieties of several fruits do not set because of the infertility of the blossoms — that is, with many fruits pollen may be produced in abundance, seemingly perfect in appearance, and potent on the pistils of other varieties, but which may wholly fail to fertilize the ovaries of the variety from which

it came. There is a great difference in the quantity of pollen produced by the varieties of the several fruits but it is doubtful if insufficiency of pollen is a factor of much importance in the failure of trees to set fruits.

Varieties that do not set fruits often have abnormal or abortive pistils or stamens. A high percentage of abnormal flowers nearly always indicates a weakness in fruit setting. Another cause of the failure to set fruits is the difference in time of maturity of stamens and pistils. When these organs do not mature at nearly the same time, fruits do not set unless pollen is supplied from some other source. The female organs of fruits are receptive, however, for several days and the pollen is not shed at once from all anthers and is produced with such prodigality as in most cases to insure the pollination of late-maturing stigmas.

The solution of the problem of self sterility in the main, then, is to so plant that varieties will be cross fertilized. It is obvious, if cross pollenization is to play an important part in fruit growing, in planting to secure it varieties must be chosen which come into blossom at the same time as those that they are expected to fertilize.

There are several causes of dropping other than lack of fertilization that need the attention of fruit growers.

Weather conditions have much to do with the dropping of fruit. Prolonged cold saps the vitality of young fruits and causes many of the more tender ones to perish and let go their hold upon the tree. Rain, whether a dashing shower or a prolonged drizzle at a low temperature, or even an extremely moist atmosphere without a fall of rain, weakens the chances of full development of fruits if such conditions prevail soon after fruit formation. Sometimes a lack of light causes fruit to drop, and thus we may explain the greater number of fruits at the tops of trees, on well pruned trees, in open-centered trees and in orchards not thickly planted.

The "June drop," especially of the peach, may be explained in part as follows: When fruits reach a certain size the food stored in the tree the previous year is exhausted. Now if the leaves of such trees are not fully expanded and if they are not able to furnish a new supply of food, the young fruits often drop. The June drop is especially liable to take place if there be one or more of the unfavorable conditions mentioned in the previous paragraphs. With some fruits there is a tendency to drop

in late summer when seeds are making great demands for food. In such cases the trees become exhausted and cast a part of their load. If at this time there be a drought, or, on the other hand, too much rain, as is often the case, fruit not infrequently drops in considerable quantities.

It seems worth while with trees which habitually drop their crop to try to direct the food to the fruit-bearing branches by pruning out surplus wood, cutting out water-sprouts, and stimulating the growth of fruit buds the previous season. All factors which are conducive to the best nutrition of the tree influence its capacity to retain the crop.

Fruits often fall because of insect or fungus injury to tree or fruit. The effects of serious injury to the foliage or the puncturing of the fruit by any one of the innumerable insect pests are too well known to demand attention, though insect injury must by no means be thought to be a sure cause of the dropping of a crop. Some insects, as coddling-moth, curculio, and the berry worms may remain until the fruit is fully developed.

Lastly, it may be of distinct advantage for a tree to drop a part of its load if it have more fruit than it can bring to the best maturity. If it does not do so naturally, the fruit grower should take the matter in hand and thin the crop.

The weather, as we have indicated in a previous paragraph, has much to do with the setting and dropping of fruit. A study of the weather as it affects the formation and development of fruit buds was made at this Station several years ago covering a period of twenty-five years beginning in 1881[1]. Since the report of this study can no longer be had the main conclusions are again published here.

During this twenty-five-year period late frosts ruined the fruit crops in western New York in four years, seriously lessened the yield in five years, and did much damage to pears, peaches and plums in three other seasons. That is to say, in more than half of the twenty-five years, "unseasonable" frosts caused serious loss to fruit growers over the section as a whole. The years of frosts appeared in cycles, as there was but one harmful frost during the first eight years of the twenty-five, then for six years in succession the crops were damaged seriously, while during the latter half of the period the frosts were more evenly distributed.

[1] U. P. Hedrick, Bul. 299 of this Station, Mch. 1908.

During seven years when frosts did little or no harm, cold, wet weather played almost as disastrous a part and reduced the crops to unprofitable proportions; while in five of the years of frost the damage was increased by the effects of cold storms. These storm years, like the frost years, came in cycles. A first short period of three years, beginning in 1881, was marked by storms, as was a longer period of seven years beginning in 1888. During the first period, wind strong enough to harm the blossoms, even without the accompanying rain, was a feature of each season, as was also the case in 1905; while in another year, without injurious rain storms, the wind alone did considerable harm to blossoms.

Sunshine at blooming time, with warm, dry weather, marked five years, only, of the twenty-five; and in each of these years the crops were excellent. In three of them the records were broken for one or another of the fruits and enormous yields were secured from practically all fruits.

From these facts, and more detailed data given in the original bulletin, we must conclude that rain and the cold and wind that usually accompany it in mid-May cause the loss of more fruit than any other agency. Killing frosts take second place as destructive forces, though the sudden, plainly evident harm they do attracts more attention and causes more complaint than the slowly developing, more concealed damage from a long, cold storm without freezing temperature.

Frosts usually blacken and destroy immediately the reproductive organs of the flowers, giving very plain evidence of harm; but such evidence is often given undue weight, so that the injury from light frosts is frequently overestimated.

Cold storms, or even very cool days without frost, at blooming time lessen or destroy the crop in several ways. The rains wash off the tiny grains of pollen from the delicate anthers of the flowers and thus prevent their journey on the body of some insect, so that they fail to perform their fertilizing office. Even if a pollen grain chance to reach the pistil it may fail to adhere and grow since the rain also washes off and dilutes the adhesive, stimulating secretion upon the stigmas. Provided neither of these causes prevents the journey and proper placing of the pollen, the cold of such storms often so lessens the vitality of the grains that they germinate very slowly or not at all.

The cold and the rain also check the activities of bees and other insects, and as these are the effective carriers of pollen

grains, the possibility of successful pollination is still further lessened.

Dampness is favorable to the growth of most fungi — which cause our leading leaf and fruit diseases — and such fungi frequently attack and ruin flowers during May storms.

Winds, alone, do comparatively slight harm to fruits early in the season, but occasionally are strong enough to whip blossoms from the trees and to prevent the flight or active work of insects. If they are drying and long continued they may evaporate the secretion from the stigmas and thereby prevent the retention and germination of the pollen; while cold, dry winds from the north at blooming time chill vegetation and retard all plant activities. On the other hand, light breezes on nights when frosts would otherwise occur may sweep away the settling chill and prevent damage; or, in favorable localities beside large bodies of water, may bring in clouds or fogs to check heat radiation and prevent freezing.

Unfortunately, at least in a narrow sense, man cannot control the weather to any great extent. Orchard heaters are now used to warm the temperature of an orchard and prevent frosts. By small fires, especially of damp, smouldering, smoke-producing materials, orchards and vineyards may occasionally be protected from light frosts. By proper placing of windbreaks — not so simple a matter as it may at first appear — some advantage may be given tender fruits. By whitewashing the trees in early spring, blossoming may be retarded a few days. A definite amount of heat is necessary to bring buds to maturity, and since white objects absorb less heat than dark ones, such whitening of the trees may occasionally carry the buds unopened safely through a frost that would destroy the flowers.

Aside from these comparatively unimportant exceptions, we can do nothing, after the orchard is established, to protect fruit trees from weather stresses. But we can do much to protect future fruit crops by careful study, before we locate the plantation, of weather conditions and crop adaptations. It would be most unwise to set apricots, plums and peaches, which are relatively tender at blossoming, in any locality where the average date for the last killing frost is as late as May 10; yet some late blooming or cold resistant varieties of even these fruits, on some hillside rightly located or beside a favoring lake, might escape frosts often enough to make their culture highly profitable since they could be sold in near markets never glutted with such fruits because of general unfavorable conditions.

In choosing a location for an orchard we must consider latitude, altitude, and general topographic conditions, especially proximity to large bodies of water, since these all affect general climatic conditions.

Perhaps fully as important as general location, however, is the choice of a particular field on which to plant fruit trees or grape vines. Omitting all discussion of soil, markets, roads, and other surroundings, the lay of the land may frequently determine its value for an orchard or vineyard. Every fruit plantation has a local climate varying in the different parts of the tract in accordance with the lay of the land. Low-lying spots show the greatest extremes — lowest temperature in cold weather and highest temperature in hot weather. Conversely, on the elevated portions of a tract the temperature is most equable — less cold in low temperature, less hot in high temperatures. The direction of the slope of the ground causes variation in the temperature probably because of the greater amount of heat absorbed from the sun by southerly slopes and because of the different exposures to prevailing winds. A slope also gives better air drainage than a level. The difference between high land and valley, slope and plain, is often amply sufficient to account for the idiosyncrasies in frost injuries so often noted.

Some fruit growers in the State claim to obtain a certain degree of immunity from frost through good air drainage secured by planting at a sufficient distance so that tops do not touch and by keeping the heads within bounds by pruning.

Quite as essential as location in doing the little that can be done to avert frost injury is the selection of varieties. Some varieties of each of the several fruits blossom later than others and these are usually in least danger of frosts. The length of time during which different varieties are in blossom is worth considering, though it varies considerably in accordance with the fruit, the variety, and, most of all, the weather.

The average length of the period of bloom for the different species of fruits is: For apples, about 9 days; for pears, 7 days; for peaches, 8 days; for plums, 7 days; for cherries, 7 days, and for grapes, 10 days. The time from first blossoms until all have dropped may vary greatly, as the blossoms of some fruits do not last longer than 48 hours in very hot, dry weather. Blossoms of tree fruits, after opening, do not close night or day, though pollination probably takes place during the day only.

Other things being equal, of course it would be in the fruit grower's favor, in a locality where late frosts are liable to occur, to select late-blooming varieties. Such varieties cannot be selected by knowing only their time of ripening; for some early fall apples blossom late, like Williams, and some late winter apples blossom early, like King and Wagener. That is, there is no correlation between the time of blooming and the time of ripening of fruits. Early varieties do not necessarily, though some may, blossom earlier than late varieties. It is not possible, therefore, by selecting late varieties to escape danger from late frosts.

ORCHARD MANAGEMENT.*

U. P. HEDRICK.

The management of an orchard is not a matter to be settled by one man for another. To give satisfactory general directions for orcharding under particular conditions is quite as impossible as it is to tell a man how to manage a business enterprise, a clergyman how to preach, a teacher to teach, or a lawyer to win cases. But some methods are common to all business, there are fundamentals in theology, teaching is based on pedagogy, and every lawyer must know something of Blackstone. So, too, there are generalities which apply to all fruit-growing. The word "generalities" is used in preference to "principles" as the latter would imply that fruit-growing is a science, which it is not, but an art to which a number of sciences contribute. It is well to understand this at the outset and so not expect in this discussion the principles and formulas of an exact science.

DIVISIONS OF FRUIT-GROWING.

The fruits of this climate fall into three classes, tree-fruits, vine-fruits, and small fruits. Orchards are plantations of any of these but we restrict the term in this discussion, as in common parlance, to plantations of tree-fruits. To classify still further, orchards are planted with two general objects in view, to produce fruits for home use and for the market. Again, commercial fruit-growing is divided into that for a special market and that for the general market. Necessary brevity forbids specific discussion of these three divisions of orcharding but the fruit-grower must not lump them together in this rough-and-ready way. The ideals for each are distinct and the methods that succeed in one division may not succeed in another. The very first question for the fruit-grower to settle is whether he is to grow for home use, a special market or the general market. Upon this decision largely rests the choice of location and the choice and number of fruits and of their varieties.

Still another division may be made. A man may elect to grow fruit extensively or intensively. In the first case the orchard is the unit. Everything is done on a large scale. There are many acres, few varieties, uniformity of method for all varieties, wholesale packing and handling; and satisfaction with a low price. In intensive fruit-growing the tree is the unit. Orchards are small; there are many varieties; special conditions and treatment are given each variety; individual trees are carefully trained, pruned and fertilized; the product is packed with all of the niceties known to the trade and sells for a high price.

* Reprint of Circular No. 24.

LOCATION OF THE ORCHARD.

Whatever the kind of fruit-growing, the choice of location demands exceedingly careful study. All subsequent efforts will fail if a mistake is made in selecting the site for operations. In growing fruit for the market certain economic considerations demand attention; as distance to market, means of transportation, labor, storage, competition, disposition of by-products, cost of production, and over-production. Any of these may prove a determinant of success and each should receive careful consideration. "The weakest goes to the wall" applies in the business of growing fruit as well as in other business enterprises. In growing fruit for home use, these economic factors may be ignored. There are, however, certain natural factors which must be observed in growing fruit for either home or market.

The first of these is latitude, which largely determines the annual temperature, the amount and intensity of sunlight, and the length of the growing season. A man must select fruits, and even more particularly varieties, with reference to latitude and its equivalent, altitude. It is easy enough to select the fruit or fruits for a region in a certain altitude or latitude but it is far from easy to select the varieties of a particular fruit. Thus, the Ben Davis, Winesap, Romanite and York Imperial groups of apples belong in southern latitudes, while the Concord grape and its seventy or more named offspring belong to the North. So with nearly all varieties of our fruits; they are either northerners or southerners and should be kept where they belong. Still the metes and bounds of latitude may be set aside by such local modifications as hills, valleys, bodies of water, direction of winds and distribution of sunshine.

SOIL.

As with all crops, the soil must largely determine the value of a location for a fruit plantation and in choosing land all of the characters, as physical structure, richness, power to retain moisture, and depth must be well considered. As everyone knows, special fruits have special soil adaptations; the peach grows on sand; the plum on clay; apples and pears on loams. But the knowledge that the several fruits have adaptations to soils is far from sufficient. A man planting fruit should know that each individual variety of any fruit will do better in some soils than in others. The fruit-grower must discover what these preferences are. The chemist and the soil physicist can help but little here; in most cases an actual test in the field is the only way of knowing whether a variety will or will not thrive in a soil. One property of the soil is too often neglected; namely, its heat-retaining properties. Some fruits, as the peach and the grape, require warm soils; apples and pears will

thrive in cooler lands, but, in general, a cold, heavy, close soil is a poor one for any of the fruits.

SELECTION OF VARIETIES.

With the location and land selected the next question is, What varieties shall I plant? This question we have touched upon in part in previous paragraphs and it only remains here to be said that out of the thousands of varieties of the several fruits even the few best ones may be most readily characterized by their faults—showing how necessary it is to make careful choice of varieties. An intimate first-hand knowledge of varieties in his own locality is the only way by which a man can become competent to choose the sorts to plant. Careful consideration will in most cases lead the planter to choose standard varieties.

SELECTING TREES.

It is about as difficult to select the trees of the several fruits as it is to make a choice of varieties. It is not of prime importance but it is true, and, therefore, worth consideration, that trees grown near home are somewhat better than those brought from a distance. Every precaution should be taken in buying to insure trees true to name and free from pests. There is scarcely a fruit-grower the country over, big or little, who has not suffered at the hands of some unscrupulous tree-dealer through substitution of varieties, through the introduction of some pest, or through buying dead or worthless trees. Other things being equal, a short, stocky tree is better than a tall, spindling one; one with many branches, better than one with few; and always the root system should be well developed.

"PEDIGREED" TREES.

The idea is current that fruits can be improved by bud-selection. It is held that the variations in fruit, tree, productiveness, vigor and hardiness to be found in varieties of fruit, can be reproduced by taking cions or buds from the plants possessing the variations. A number of nurserymen are putting this theory in practice and trees are now offered for sale with a "pedigree" to show that they came from known, good ancestry. But there is no evidence that any sort of fruits has come into existence by continuous selection; that any variety has been improved, or that any variety has degenerated through the cumulative action of natural or artificial selection. No precise experimental evidence has been offered to prove that varieties of fruit can be changed in the least by continuous bud-selection. Fruit-growers should steer clear of "pedigreed stock" and "improved strains" of varieties until the new production can be seen somewhere by competent judges growing side by side with the parents.

STOCKS FOR TREES.

Unfortunately few fruit-growers concern themselves with the kind of stocks their trees are worked upon. Yet this is a most important matter. Apples may be bought upon Paradise, Doucin, or home-grown or French-grown standards. The first two named are suitable only for the amateur, and, of the standards, those on the foreign seedlings are usually much the better. Pears are grown as standards on French seedlings or as dwarfs on the Angers quince. The dwarfs are gradually going out of vogue. The peach should be worked upon seedlings from southern pits and not upon those from cannery seeds. Sour or sweet cherries on Mazzard stock are far superior to those on the Mahaleb stock, yet the latter is usually planted because easier for the nurseryman to grow and therefore cheaper for the cherry-grower to buy—a great mistake on the part of the grower, as trees on Mahaleb stock are dear at any price. Plums are grown upon several stocks and no one seems to know which are the best for the several species of this fruit, the different types of soil, and the hundreds of varieties.

LAYING OUT THE ORCHARD.

After the trees are on hand the vexed problem arises as to how the orchard is to be laid out—whether in squares, quincunxes, hexagons, with or without fillers, and at what distances apart. Planting in squares is usually best because it permits orchard operations to be carried on most readily. Both roots and branches will utilize all of the space. Fillers of fruits other than varieties of the same species as the permanent trees are not desirable. They greatly complicate orchard operations and under treatment meant primarily for the permanent trees they are neither "fish, flesh, fowl, nor good red herring." Fillers of quick-bearing varieties of the same fruit, especially the apple, may often be used to advantage. There should be as many "outside rows" as possible. That is, the trees should be far enough apart for each to develop in full its individuality; for every fruit-grower knows that the trees on the outside of his orchard produce most fruit, since they get most air, sunshine, wind, moisture and food.

IMPOTENCY OF VARIETIES.

A good deal is being said about the impotency of varieties whereby their fruits do not sell well. Fruit does not set in this region for most part because of frosts, cold weather, rains and heavy winds at blooming time, but still there are some varieties of pears, apples, grapes and plums, at least, that are self-sterile. The remedy is mixed planting of varieties that bloom at the same time. It is important that the fruit of all of the varieties planted have value

as it is not worth while to encumber land with a sort fit only for a pollinator. Contrary to a very general notion the fruits themselves are not greatly changed, if at all, by cross-pollination.

TIME TO SET AND AGE OF TREE.

There is a marked gain in setting varieties of apples late in the fall if the trees be two-year-olds. All other fruits and one-year-old apples should be set as early as possible in the spring. Two-year-old trees are usually to be preferred to those but one year old if they have been properly headed in the nursery. With the peach, one-year-old trees should always be planted.

USE OF DYNAMITE IN DIGGING HOLES.

Dynamite is being widely advertised for use in digging holes for trees. There is little positive evidence to show that trees thrive better in holes made by using dynamite and until such evidence is forthcoming it is better that the holes be dug as it is quite as probable that harm rather than good will be done through the use of explosives.

TOP-WORKING YOUNG TREES.

The practice of setting a thrifty variety of apples or pears and grafting or budding a weaker or less healthy variety wanted, has many advocates. This top-working is probably a procedure worth while with a very few varieties. In general, however, the chances of getting malformed, lop-sided trees and of delaying the bearing period are so great that top-working cannot be recommended except for a very few sorts that seem difficult to grow on their own roots. They can be best top-worked in the nursery.

PRUNING AT TRANSPLANTING TIME.

We are ready to set the tree and the problem of pruning is before us. It is necessary to cut away part of the branches to enable the injured root system to supply the remaining branches with water. The less the roots are injured the less the top need be cut away. The common way is to cut back all of the branches. This, in many cases, is wrong. The top buds on a branch develop soonest and produce the largest leaves. A newly set tree will grow best if it can develop a large leaf surface before dry, hot weather sets in, and this it will do if some branches are left intact. Therefore, instead of shortening-in all branches, cut away some of the branches entirely. The tree so pruned will start growth and acquire vigor more quickly.

HEIGHT OF HEAD.

A decisive choice must be made at the very start as to the height of the head. The choice should usually be for a low-headed tree for the reason that such a tree is more easily sprayed and pruned and the fruit more readily thinned and harvested. Crop and tree are less subject to injury by wind; the trunk is less liable to injury by sunscald, winter-killing and parasites; the top is more quickly formed and the low-headed tree soonest bears fruit. No advantage as to cultivation is gained by either method over the other, as a well trained tree with a low head, in which the branches ascend obliquely, permits the cultivator to come sufficiently near the tree. By low-headed is meant a distance from earth to the first limb of from one to two feet. The peach may be headed at the lower distance, the plum, pear and cherry somewhat higher, while the apple should approach the upper limit.

FORM OF HEAD.

Two general types of top are open to choice; the vase form or open-centered tree, and the globe or close-centered tree. In the first the frame-work of the tree consists of a short trunk surmounted by four or five main branches ascending obliquely. In the close-centered tree the trunk is continued above the branches, forming the center of the tree. There are several modifications of each of these. In this climate the open-headed, vase-formed tree is best for the peach and the close-centered two-story tree is best for all other fruits. Whatever the form, care should be taken that the lowest branches are longest, so that the greatest possible leaf-surface will be exposed to the sun and light.

PRUNING FOR WOOD.

For several years after planting, the peach alone excepted, fruit trees need to be pruned only to train the tree. Just how much to prune young trees depends upon the fruit, the variety, the soil and the climate. Fruit-growers usually prune trees far too much, thereby increasing the growth of wood and delaying the fruiting of the plant. If trees were originally well selected all that is needed is to remove an occasional branch which starts out in the wrong place—the sooner done the better—and to take out dead, injured or crossed limbs. The peach, some plums and some pears may need heading-in, and a weak or sickly tree may require somewhat more severe pruning.

If a tree is bearing many small fruits, if the top contains dead or dying branches, or if the seasonal growth is short and scant, it may be taken for granted that the tree lacks vigor, or, in old trees, is passing into decrepitude. Such trees may usually be rejuvenated by judicious pruning. In professional terms the tree must be

"pruned for wood." Such pruning consists in cutting back a considerable number of branches and in wholly removing others. In pruning for wood the following rules are usually applicable:

Weak-growing varieties may always be pruned generously; strong-growing kinds, lightly.

Varieties which branch freely need little pruning. Those having unbranching limbs should be pruned closely.

In cool, damp climates trees run to wood and need little pruning. In hot, dry climates they need much pruning.

Rich, deep soils favor growth; prune trees in such soils lightly. In shallow, sandy soils, trees produce short shoots, and the wood should be closely cut.

PRUNING FOR FRUIT.

A barren tree can sometimes be made to bear fruit by proper pruning. Not infrequently barrenness is caused by over-manuring or over-stimulation of some kind, because of which the numbers of shoots and leaves are greatly increased, but flower buds do not form. This over-production of wood and leaf can sometimes be stopped by breaking or cutting off the greater portion of the season's growth in the summer. Summer pruning is a weakening process and in this climate may greatly decrease the vigor of the plants if frequently resorted to. The practice is neither common nor often necessary in this State except in the case of dwarf apples and pears.

PRUNE ACCORDING TO HABIT.

In pruning, the habit of the tree must always be considered. When trees have a spreading, drooping or long, slender habit of growth, prune to buds that point upward or to the center of the plant. If the habit be upright and dense, cut to lower or outer buds and so spread the compact top. The "off-year" habit of bearing is intensified by spasmodic and severe pruning. Prune biennial bearers rather conservatively and early. The heads of all young trees may be left fairly dense, for when the trees come in bearing the weight of the crop opens the head; meanwhile, by saving the foliage you have obtained a larger trunk and more bearing wood.

HEADING-IN.

Heading-in makes the top of a tree thicker and broader. There are but few orchards or even trees that do not need more or less heading-in at some time in their history. But in our climate this form of pruning is practiced only with peaches and some plums, and is but little needed with other fruits. In winter pruning, the cutting back of exceedingly long branches for the thickening of the top of occasional trees or varieties is the exception rather than the

rule. Peaches and some plums bear fruit on the wood of the past season. The crop is borne progressively away from the trunk. It is necessary to head-in these fruits to keep the bearing wood near the trunk. Apples, pears, most plums, and cherries are borne on spurs from wood two or more years old, and, therefore, with these heading-in is not a regular practice.

SUCKERS.

When a tree is severely pruned a growth of long, vertical shoots with few leaves often follows—suckers or water sprouts. Since the sparseness of foliage prevents the shoots from elaborating food they appropriate it from the parts upon which they grow. Suckers are, therefore, robbers, true parasites, and should be removed whenever and wherever found. Occasionally they may be used in the development of normal branches, though their value for this purpose is small.

MAKING THE CUT.

The cut in pruning should always be made parallel with the trunk and as close as possible. One of the most elementary rules of pruning is that the cut should be made just beyond a healthy lateral branch. The reason for so cutting is plain. The lateral branch is stimulated to produce a great number of leaves which assimilate sap. This elaborated food passes back through the inner bark near the newly made cut and the wound quickly calluses and heals because it thus has access to an abundant supply of food.

The notion prevails that a wound of any size will heal, but the majority of wounds over three inches in diameter do not heal. Decay sets in, caused by wood-destroying fungi, and there soon follow, with the action of the weather, rotten wood, a hollow branch and a diseased tree. The life of a tree is endangered whenever a large branch is removed, and such an amputation should be made only under dire necessity. One of the secrets of the healing of large wounds is to cut close to the trunk, and no matter how large a wound may be it is better than leaving a projecting stub. The chances for healing with a large wound are materially increased by a coating of thick lead paint to protect the cut surface from evaporation and moisture. It is a waste of time to paint wounds less than two inches in diameter.

TIME TO PRUNE.

Pruning is often left to " time and chance " but there is a best time, which is late winter before the sap flows. The objection to early winter pruning is that there may be injury to the tissues near the wound from cold or from checking. Late spring pruning results in loss of sap and the fluids run down the bark and keep it wet and

sticky, making a suitable place for the spores of various rot fungi so that decay may set in. In practice it is often found necessary to prune from the time leaves drop until they are well started in the spring.

CULTIVATING THE ORCHARD.

Cultivation is generally practiced with all fruits except the apple; some claim that this fruit can be grown better in sod; in which case the grass may be cut as a mulch or it may be kept down by sheep, pigs or cattle. The various modifications of the sod method of managing orchards have come to the fore because of the performance of a few individual orchards in the State. But these orchards are the exception and not the rule. No one knows whether they would not have done better under tillage than under sod; for results have not been given the public which show comparative data from the two methods in any of the orchards.

The New York Agricultural Experiment Station has two experiments to test methods of orchard management. The following table shows the outcome of one of those experiments at the end of five years:

EXPENSE AND INCOME FROM A SOD-MULCHED AND A TILLED ORCHARD.

Year	Sod plat — 118 trees				Tilled plat — 121 trees			
	Cutting grass	Harvesting crop	Total expense	Net income	Cultivation	Harvesting crop	Total expense	Net income
1904.....	$19.99	$219.25	$327.14	$225.76	$33.75	$210.90	$332.55	$185.34
1905.....	7.46	82.89	166.47	330.28	48.71	96.85	221.68	355.60
1906.....	3.36	104.30	186.29	154.96	30.30	231.80	340.73	392.42
1907.....	3.67	138.07	239.28	487.16	46.63	224.20	371.35	800.31
1908.....	6.14	173.43	246.88	353.86	36.67	338.59	447.82	723.41
Total..	$40.62	$717.94	$1,166.06	$1,552.03	$196.06	$1,102.34	$1,714.13	$2,457.08

Allowing 27.2 trees to the acre, these figures show that the average expense of production was $53.75 an acre annually under the sod-mulch system and $76.06 under tillage, an advantage for the sod-mulch of $22.31 an acre; but the net income from an acre in sod was $71.52 and from an acre in tillage $110.43, an advantage for tillage of $38.91. That is, every dollar of the additional expenditure ($22.31) made necessary by adopting the tillage method was not only returned but brought an extra $1.74 of profits with it.

IS IT NECESSARY TO FERTILIZE AN ORCHARD?

Is it necessary to fertilize an apple orchard? In the average western New York tilled apple orchard, if it be well drained, well

tilled and properly supplied with organic matter from stable manure or cover crops, commercial fertilizers are little needed. The exceptions will probably be found on sandy and gravelly soils deficient in potash or the phosphates and subject to droughts; or on soils of such shallowness or of such mechanical texture as to limit the root range of the apple plant; or in soils so wet or so dry, or so devoid of humus, as to prevent proper biological activities in the soil. These exceptions mean for the most part that a soil in this region possessing the unfavorable qualities named is unfitted for apple culture—at any rate there are still thousands of acres of available fruit land in every part of the apple regions of New York that do not fall in with the exceptions. There are probably many apple orchards in New York that may be benefited by an application of one of the chief elements of fertility. Some may require two of the elements. Few, indeed, should require a complete fertilizer.

How may a fruit-grower know whether his trees need fertilizers? It may be assumed at once that if trees are vigorous, bearing well and making a fair amount of new wood each season, they need no additional plant food. If the trees are not in the healthful condition described, the logical thing to do is to look to the drainage, tillage and health of the trees first and the more expensive and less certain fertilization afterward.

As a last resort, fertilizers ought not to be used to rejuvenate trees unless the owner has obtained positive evidence that his soil is lacking in some of the elements of plant food. To obtain such evidence a fruit-grower should carry on a fertilizer experiment.

In making such a test, select a portion of the orchard as uniform as possible, both in soil and varieties. If available, use at least five trees for each plat and on different plats use fertilizers about as in this Station test: (1) Acid phosphate to give about 50 pounds of phosphoric acid to the acre, or 13 pounds of 14 per ct. phosphate to each tree if they stand 40 feet apart; (2) phosphate as above and muriate of potash to give 100 pounds of potash to the acre, or 8 pounds of muriate per tree; (3) phosphate and muriate as above and nitrate of soda and dried blood to give 50 pounds of nitrogen per acre, or 13 pounds of medium grade dried blood and 3¾ pounds of nitrate of soda per tree. This nitrogen might also be supplied in six tons of good stable manure to the acre, or 400 pounds per tree; (4) this amount of stable manure should be applied on a fourth plat, and (5) a similar plat should be left unfertilized for a check. This experiment is much less laborious and complex than it looks, for the fertilizer combinations are built up one from another and the mixing can be done and quantities weighed out in winter when orchard work is not pressing.

The fertilizers should be applied in the spring as soon as the ground can be worked, spreading them about the trees over an area somewhat greater than that covered by the spread of the branches.

Apply the manure before plowing, and the fertilizers immediately after it, harrowing them in. The experiment, to be conclusive, should run for several years and the crops should be carefully weighed or measured, giving due consideration to culls and windfalls.

INTER-CROPS AND COVER-CROPS.

The best modern practice permits the growing of hoed crops in an orchard until the trees come into bearing. If profitable disposition can be made of the product, truck crops are ideal for a young orchard. Of these peas and beans take less from the soil than other crops and may add a little nitrogen to it. But beside these, cabbage, potatoes, tomatoes, cucumbers or similar crops may be grown advantageously. Corn is the only farm crop permissible and is not as desirable as any of the truck crops named.

As regards cover-crops, the best modern practice insists that one be sowed at the close of the season's cultivation, about August first, to be plowed under the next spring. Various crops may be sown alone or in combination. The several purposes of a cover-crop—to cover the ground, and add humus and nitrogen—are usually best served by a combination crop. Of several that may be recommended, this Station prefers the following: On each acre sow one bushel of oats or barley and fifteen pounds of mammoth red clover or twenty pounds of winter vetch.

PESTS.

In the present-day fruit-growing the horticulturist is not permitted to say much about insects, fungi and spraying. The botanist and the entomologist are indispensable here, yet the fruit-grower can so plant as to avoid some of the warfare with pests. Thus King, Roxbury and Northern Spy among apples are nearly free from scale as are the Kieffer, LeConte and Winter Nelis pears, Bradshaw and Field plums and all sour cherries. There are about thirty varieties of apples on the grounds of the New York Agricultural Experiment Station never injured by scab, as many more scarcely injured, and of course a large number that are badly injured. The Seckel, Kieffer, Le Conte and Winter Nelis pears do not blight badly. A few plums are never attacked by black-knot and some peaches are almost immune to leaf curl. Now with these, and nearly all other pests, men who can not or will not spray, the general farmer and the city suburbanite, for example, should plant varieties measurably immune to the most troublesome pests. Commercial fruit-growers must spray.

MICE AND RABBITS.

It is necessary to protect young trees from mice and rabbits. The best protection against mice is a mound of earth about the tree

several inches high thrown up in late fall and removed in early spring. Wire netting is the best protection against rabbits. When injury has been done the trees can often be saved by bridge-grafting.

CONCLUSION.

Lastly, the fruit-grower, of all tillers of the soil, should know the plants he works with; should have an insight into their life processes; should know how they are affected by external conditions; should understand the more or less distinct individuality of his trees. Fruit plants are various in kind and trees of one kind are often quite unlike because the conditions under which they are grown are dissimilar. It follows, then, that conditions must vary for every person who grows fruit and that there must, therefore, be more or less diverse ideals, diverse methods and diverse results. But certain forces, embraced in what we call "good care," have brought all fruits from the wild to their present state of domestication, and these forces modified and refined as we gain new knowledge, must be kept in constant operation.

REPORT

ON

INSPECTION WORK.

W. H. Jordan, *Director.*
E. L. Baker, *Associate Chemist.*
A. W. Clark, *Assistant Chemist.*
M. P. Sweeney, *Assistant Chemist.*
Otto McCreary, *Assistant Chemist.*
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TABLE OF CONTENTS.

INSPECTION OF FEEDING STUFFS.‡

This bulletin gives the results of the analyses† of samples of feeding stuffs collected by the Commissioner of Agriculture during the fall and winter of 1912–13 and by him transmitted for analysis to the Director of the New York Agricultural Experiment Station, in accordance with the provisions of Article VII of the Agricultural Law. These analyses are published by the Director of the New York Agricultural Experiment Station in accordance with the provisions of section 164 of said Article.

ANALYSES OF SAMPLES OF FEEDING STUFFS.

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.
			Per ct.	*Per ct.*	*Per ct.*
	COTTONSEED MEALS:				
4718	The American Cotton Oil Co., Jackson, Tenn. "Choice Cottonseed Meal"	Sanitaria Springs	G* 41. F* 42.4	9. 8.39	10.50 6.48
5000	The American Cotton Oil Co., Grenada, Miss. " Prime Cotton Seed Meal "	Middletown	G 38.61 F 38.5	8. 8.26	11.50 8.99
5405	American Milling Co., Chicago, Ill. " Amco Cotton Seed Meal "	Ravena	G 41. F 43.7	8. 7.75	10. 7.93
5037	F. W. Brode & Co., Memphis, Tenn. " Cub Brand Prime Cotton Seed Meal "	Norwich	G 40. F 38.4	6. 6.76	10. 10.26
5304	F. W. Brode & Co., Memphis, Tenn. " Dove Brand Cotton Seed Meal "	Buffalo	G 38.62 F 37.3	6. 8.07	10. 9.91
4617	F. W. Brode & Co., Memphis, Tenn. " Owl Brand High Grade Cotton Seed Meal "	Madrid Springs	G 41 F 40.94	6. 8.76	10. 7.30
4673	F. W. Brode & Co., Memphis, Tenn. " Owl Brand High Grade Cotton Seed Meal "	Darien Center	G 41. F 41.04	6. 8.51	10. 7.45

* These letters indicate, respectively, Guaranteed and Found.
† The analyses herewith published are made in charge of the Chemical Department of the Station, the immediate oversight of the work being assigned to E. L. Baker. Associate Chemist.

‡ Reprint of Bulletin No. 366, August, 1913.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.
			Per ct.	*Per ct.*	*Per ct.*
	COTTONSEED MEALS (*continued*):				
4702	F. W. Brode & Co., Memphis, Tenn. "Owl Brand High Grade Cotton Seed Meal"	Cohocton	G* 41. F* 40.94	6. 9.75	10. 8.71
4731	F. W. Brode & Co., Memphis, Tenn. "Owl Brand High Grade Cotton Seed Meal"	Syracuse	G 41. F 41.5	6. 7.59	10. 6.57
4775	F. W. Brode & Co., Memphis, Tenn. "Owl Brand High Grade Cotton Seed Meal"	Troy	G 41. F 43.3	6. 7.05	10. 7.10
4812	F. W. Brode & Co., Memphis, Tenn. "Owl Brand High Grade Cotton Seed Meal"	Collins	G 41. F 38.0	6. 8.39	10. 9.69
4912	F. W. Brode & Co., Memphis, Tenn. "Owl Brand High Grade Cotton Seed Meal"	Dansville	G 41. F 38.7	6. 7.05	10. 10.07
5044	F. W. Brode & Co., Memphis, Tenn. "Owl Brand High Grade Cotton Seed Meal"	Cortland	G —— F 41.2	—— 9.26	—— 9.89
4800	The Buckeye Cotton Oil Co., Cincinnati, O. "Buckeye Prime Cotton Seed Meal"	Cherry Valley	G 38.50 F 39.	6.50 8.08	10. 8.98
4628	T. H. Bunch Commission Co., Little Rock, Ark. "Old Gold Brand Pure Cotton Seed Meal"	Mexico	G 41. F 38.2	9. 8.18	9. 8.33
4618	Chapin & Co., Inc., Hammond, Ind. "Green Diamond Brand Choice Cotton Seed Meal"	Madrid	G 41. F 43.51	8. 8.01	10. 6.94
5212	S. P. Davis, Little Rock, Ark. "Good Luck Brand Cotton Seed Meal"	Waverly	G 41. F 41.1	7. 8.88	10.50 7.44

* These letters indicate, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.		Crude protein.	Crude fat.	Crude fiber.
				Per ct.	*Per ct.*	*Per ct.*
	COTTONSEED MEALS (*continued*):					
5342	The Dewey Bros. Co., Blanchester, O. "Queen Cotton Seed Meal"	Sherman	G*	41.	7.	10.
			F*	40.7	7.66	10.70
4703	East St. Louis Cotton Oil Co., National Stock Yards, Ill. "Cotton Seed Meal, Our 'Illinois' Brand"	Cohocton	G	41.50	——	10.
			F	44.25	10.96	4.51
5255	Farmers Cotton Oil & Trading Co., Uniontown, Ala. "High Grade Cotton Seed Meal"	Oneonta	G	41.	9.	7.
			F	40.9	9.19	7.04
5063	A. H. Herrick & Son, Watertown, N. Y. "Cotton Seed Meal"	Watertown	G	——	——	——
			F	41.5	8.98	7.12
4663	Humphreys, Godwin Co., Memphis, Tenn. "Dixie Brand Cotton Seed Meal"	Attica	G	38.62	6.	12.
			F	38.94	8.05	9.16
4909	Imperial Cotto Milling Co., Memphis, Tenn. "Imperial Cotto Brand Choice Cotton Seed Meal"	Warsaw	G	41.	8.	9.
			F	38.6	7.16	9.51
4642	Keeton-Krueger Co., Atlanta, Ga. "Choice Peacock Brand Cotton Seed Meal"	Central Square	G	41.	6.	10.
			F	42.66	8.37	7.20
5027	Keeton-Krueger Co., Atlanta, Ga. "Peacock Brand Cotton Seed Meal"	Walton	G	41.	6.	10.
			F	39.8	6.42	9.83
5112	Kemper Mill & Elevator Co., Kansas City, Mo. "Choice Cotton Seed Meal"	Franklinville	G	41.	7.50	10.
			F	38.9	9.33	8.97
5097	A. J. Loucks, Copenhagen, N. Y. "Cotton Seed Meal"	Copenhagen	G	——	——	——
			F	43.	7.28	7.13
4621	National Feed Co., St. Louis, Mo. "Prime Cotton Seed Meal"	Ogdensburg	G	41.	7.50	14.
			F	40.29	8.26	8.33

* These letters indicate, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.
			Per ct.	*Per ct.*	*Per ct.*
	COTTONSEED MEALS (*continued*):				
4832	W. C. Nothern, Little Rock, Ark. " Bee Brand Cotton Seed Meal Cake "	Jamestown	G* 41. F* 39.6	7. 10.70	10.50 9.72
4857	W. C. Nothern, Little Rock, Ark. " Bee Brand Cotton Seed Meal Cake "	Wyoming	G 41. F 40.8	7. 8.69	10.50 7.87
4683	W. Newton Smith, Baltimore, Md. " Dirigo Brand Cotton Seed Meal "	Bergen	G 41. F 41.1	7. 8.04	10.50 8.75
4823	W. Newton Smith, Baltimore, Md. " Dirigo Brand Cotton Seed Meal "	Akron	G 41. F 41.4	7. 7.11	10.5 9.39
5195	J. E. Soper Co., Boston, Mass. " Pioneer Cotton Seed Meal "	Greenwich	G 41. F 40.7	7. 7.70	10. 8.17
5086	Union Brokerage & Commission Co., Vicksburg, Miss. " Durjan Brand High Grade Cotton Seed Meal "	Antwerp	G 41. F 43.1	7.5 8.25	9. 7.12
	LINSEED MEALS:				
4657	American Linseed Co., New York, N. Y. " Old Process Oil Meal "	Attica	G 34. F 36.13	5. 5.61	8. 8.18
4726	American Linseed Co., New York, N. Y. " Old Process Oil Meal "	Binghamton	G 34. F 35.3	5. 5.72	8. 7.68
4784	American Linseed Co., New York, N. Y " Old Process Oil Meal '	Cobleskill	G 34. F 32.5	5. 5.73	8. 7.63
4802	American Linseed Co., New York, N. Y. " Old Process Oil Meal "	Buffalo	G 34. F 36.	5. 5.23	8. 7.78
5096	American Milling Co., Chicago, Ill. "Amco Old Process Linseed Meal "	Copenhagen	G 32. F 33.4	6. 6.71	11. 8.41
5229	American Milling Co., Chicago, Ill. " Amco Old Process Linseed Meal "	Lestershire	G 32. F 32.0	6. 7.77	11. 7.03

* These letters indicate, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.
			Per ct.	*Per ct.*	*Per ct.*
	LINSEED MEALS (*continued*):				
5039	Archer-Daniels Linseed Co., Minneapolis, Minn. "Old Process Ground Oil Cake"	Oxford	G* 32. F* 33.6	6. 6.03	10. 8.39
4872	Hauenstein & Co., Buffalo, N. Y. "Old Process Linseed Meal"	Geneva	G 30. F 31.2	5. 6.15	10. 7.44
5315	Imperial Cotto Milling Co., Peoria, Ill. "Imperial Cotto Brand Pure Old Process Linseed Meal"	Jamestown	G 32. F 33.7	7. 9.95	8. 7.51
4626	Kelloggs & Miller, Amsterdam, N. Y. "Pure (Old Process) Oil Meal"	Pulaski	G 33. F 34.07	5. 6.94	7.50 7.86
4963	Kelloggs & Miller, Amsterdam, N. Y. "Pure (Old Process) Oil Meal"	Gloversville	G 33. F 34.	5. 6.38	7.5 7.77
4630	The Guy G. Major Co., Toledo, O. "Old Process Oil Meal"	Mexico	G 30. F 30.69	5. 6.44	10. 8.63
4660	The Guy G. Major Co., Toledo, O. "Old Process Oil Meal"	Attica	G 30. F 33.43	5. 6.10	10. 8.38
4794	The Guy G. Major Co., Toldeo, O. "Old Process Oil Meal"	Richmondville	G 30. F 29.8	5. 5.84	10. 7.69
4824	The Guy G. Major Co., Toledo, O. "Old Process Oil Meal"	Akron	G 30. F 32.9	5. 6.81	10. 7.96
4819	The Mann Bros. Co., Buffalo, N. Y. "Pure Old Process Linseed Oil Meal"	North Collins	G 34. F 35.4	6. 6.69	10. 8.03
4707	The Metzger Seed and Oil Co., Toledo, O. "Old Process Oil Meal"	Binghamton	G 30. F 32.3	5. 6.87	10. 8.71
4815	The Metzger Seed & Oil Co., Toledo, O. "Old Process Oil Meal"	Collins	G 30. F 33.9	5. 5.77	10. 8.90

* These letters indicate, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.
			Per ct.	*Per ct.*	*Per ct.*
	LINSEED MEALS (*continued*):				
5301	Midland Linseed Products Co., Minneapolis, Minn. "Old Process Ground Linseed Cake"	Wellsville	G* 32. F* 32.6	6. 6.31	8.50 8.34
5083	National Feed Co., St. Louis, Mo. "Pure Old Process Linseed Meal"	Carthage	G 34. F 33.9	7. 9.18	7. 7.09
4738	The Sherwin-Williams Co., Cleveland, O. "Linseed Oil Meal"	Syracuse	G 33. F 33.8	6. 6.51	8. 8.
	MALT SPROUTS:				
4635	The American Malting Co., Syracuse, N. Y. "Malt Sprouts" †	New Haven	G 21.35 F 23.	1.92 1.86	13.40 16.72
4669	Atlantic Export Co. of Wis., Chicago, Ill. "Malt Sprouts"	Darien Center	G 22. F 27.50	1. 2.19	16. 10.78
4753	Atlantic Export Co. of Wis., Chicago, Ill. "Malt Sprouts"	Albany	G 22. F 25.8	1. 1.73	16. 12.
5167	P. Ballantine & Sons, Newark, N. J. "Malt Sprouts"	Washington-ville	G 25.63 F 24.5	1.47 1.82	12.77 14.95
5213	M. F. Baringer, Philadelphia, Pa. "Malt Sprouts"	Waverly	G 25. F 22.5	1.60 1.66	13. 14.36
4879	Bartholomay Brewery Co., Rochester, N. Y. "Malt Sprouts" ‡	Rochester	G 21. F 25.5	2.26 1.69	18.91 12.6
5321	H. V. Burns, Buffalo, N. Y. "Malt Sprouts" ‡	Buffalo	G 23.70 F 26.1	1. 2.55	14. 10.88
4957	Donahue-Stratton Co., Milwaukee, Wis. "Hiquality Malt Sprouts"	Guilderland Center	G 25. F 23.4	1.50 1.68	14. 12.32

* These letters indicate, respectively, Guaranteed and Found.
† Contains coal dust.
‡ Contains a few weed seeds.

Analyses of Samples of Feeding Stuffs (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.
			Per ct.	*Per ct.*	*Per ct.*
	Malt Sprouts (*continued*):				
3857	Farmers Feed Co., New York, N. Y. "Malt Sprouts"	New York	G* 26.06 F* 25.9	1.57 1.93	12.95 11.51
4955	The Fleischmann Malting Co., Buffalo, N. Y. "Malt Sprouts" †	Altamont	G 24. F 24.8	1. 3.07	13. 11.10
5108	The Fleischmann Malting Co., Buffalo, N. Y. "Malt Sprouts"	Franklinville	G 24. F 25.6	1. 2.08	13. 11.29
5239	Forrest-Utley Co., Dixon, Ill. "Malt Sprouts" ‡	Binghamton	G 23. F 18.6	2. 2.07	14. 15.96
5082	Geneva Malting Co., Geneva, N. Y. "Malt Sprouts"	Lowville	G 26.50 F 25.2	2.45 1.70	10.49 10.23
4655	John Kam Malting Co., Buffalo, N. Y. "Malt Sprouts" ‡	Attica	G 25. F 24.22	.75 1.55	16. 10.91
4818	John Kam Malting Co., Buffalo, N. Y. "Malt Sprouts"	North Collins	G 25. F 25.7	1. 1.80	16. 13.72
5331	Kreiner & Lehr, Buffalo, N. Y. "Malt Sprouts" ‡	Buffalo	G 22. F 26.5	1.5 1.84	12.89 11.12
5163	Lembeck & Betz Eagle Brewing Co., Watkins, N. Y. "Malt Sprouts"	Monroe	G 28.70 F 27.3	1.61 2.00	13.05 10.81
5232	Geo. J. Meyer Malting Co., Buffalo, N. Y. "Malt Sprouts"	Sherburne	G 20.82 F 26.9	1.4 1.67	14. 12.96
4814	Henry C. Moffat, Buffalo, N. Y. "Malt Sprouts" ‡	Collins	G 25. F 22.8	1.60 2.39	12. 12.76
5333	Perot Malting Co., Buffalo, N. Y. "Malt Sprouts"	Buffalo	G 23. F 26.0	.5 1.49	18. 13.0

* These letters indicate, respectively, Guaranteed and Found.
† Contains a large amount of weed seeds.
‡ Contains a few weed seeds.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.
			Per ct.	*Per ct.*	*Per ct.*
	MALT SPROUTS (*continued*):				
4633	M. G. Rankin & Co., Milwaukee, Wis. "Jersey Malt Sprouts"	Mexico	G* 25. F* 26.63	1.50 1.72	17. 12.14
4834	M. G. Rankin & Co., Milwaukee, Wis. "Jersey Malt Sprouts" †	Jamestown	G 25. F 25.3	1.50 2.09	17. 12.48
5256	Stewart Barton & Co., Oneida, N. Y. "Malt Sprouts" †	Oneida	G 18. F 25.7	1. 2.49	15. 12.48
4886	William Taylor, Lyons, N. Y. "Malt Sprouts" ‡	Clyde	G 26. F 24.1	1.75 3.11	12. 12.08
5318	The C. Zwickel Malting Co., Buffalo, N. Y. "Malt Sprouts" §	Buffalo	G 25. F 28.2	2. 1.92	11. 14.12
	DRIED DISTILLERS' GRAINS:				
4656	Ajax Milling & Feed Co., New York, N. Y. "Ajax Flakes"	Attica	G 30. F 27.	11. 8.48	14. 11.58
4684	Ajax Milling & Feed Co., New York, N. Y. "Ajax Flakes"	Churchville	G 30. F 31.3	11. 12.62	14. 10.58
4785	Ajax Milling & Feed Co., New York, N. Y. "Ajax Flakes"	Cobleskill	G 30. F 30.9	11. 12.30	14. 7.67
4638	Atlantic Export Co. of Wis., Chicago, Ill. "No. 2 Atlantic Grains"	Fulton	G 26. F 23.98	6. 8.80	14. 10.24
5047	Atlantic Export Co., of Wis., Chicago, Ill. "Atlantic Grains"	McGraw	G 28. F 27.9	6. 9.49	14. 10.44
4623	The J. W. Biles Co., Cincinnati, O. "XXXX Fourex Grains"	Ogdensburg	G 31. F 30.13	12. 11.98	13. 8.81

* These letters indicate, respectively, Guaranteed and Found.
† Contains weed seeds.
‡ Contains large amount of weed seeds.
§ Guarantee: Small percentage of weed seeds and screenings.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.
			Per ct.	*Per ct.*	*Per ct.*
	DRIED DISTILLERS' GRAINS (*continued*):				
4840	The J. W. Biles Co., Cincinnati, O. " Fourex Distillers' Dried Grains "	Randolph	G* 31. F* 31.5	12. 13.30	13. 11.03
4831	Clark Bros. & Co., Peoria, Ill. " Empire State Dairy Feed "	Jamestown	G 29. F 32.6	12. 12.71	12. 9.15
4906	Clark Bros. & Co., Peoria, Ill. " Empire State Dairy Feed "	Silver Springs	G 29. F 32.6	12. 10.89	12. 9.12
4972	Clark Bros. & Co., Peoria, Ill. " Empire State Dairy Feed "	Canajoharie	G 29. F 31.4	12. 11.94	12. 9.12
4796	Continental Cereal Co., Peoria, Ill. " Continental Gluten Feed "	Richmondville	G 29. F 29.7	12.5 11.43	10.5 6.95
5418	Continental Cereal Co., Peoria, Ill. " Continental Gluten Feed "	Stamford	G 29. F 27.9	12.5 11.29	10.5 6.80
4651	The Dewey Bros. Co., Blanchester, O. " Corn 3 D Grains "	Batavia	G 26. F 27.28	9. 10.14	13. 7.82
4722	The Dewey Bros. Co., Blanchester, O. " Corn 3 D Grains "	Binghamton	G 26. F 26.3	9. 10.42	13. 6.92
4902	The Dewey Bros. Co., Blanchester, O. " Corn 3 D Grains " †	Avon	G 26. F 24.4	9. 10.39	13. 6.71
4652	The Dewey Bros. Co., Blanchester, O. " Eagle 3 D Grains "	Batavia	G 30. F 32.56	10. 13.13	13. 12.02
4714	The Dewey Bros. Co., Blanchester, O. " Buckeye Gluten Feed " ‡	Sanitaria Springs	G 20. F 21.3	5. 4.35	15. 10.03
5353	The Dewey Bros. Co., Blanchester, O. " Bourbon 3 D Grains "	Newport	G 24. F 29.4	8. 10.85	14. 9.60

* These letters indicate, respectively, Guaranteed and Found.
† Contains dried distillers' grains, light barley, and grain screenings.
‡ Rye distillers' grains.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.
			Per ct.	Per ct.	Per ct.
	DRIED DISTILLERS' GRAINS (*continued*):				
4686	Hermann Deutsch Co., Milwaukee, Wis. "Climax Corn Distillers' Grains"	Alexander	G* 30. F* 32.4	10. 13.11	15. 11.04
4636	Hottelet & Co., Milwaukee, Wis. "National Dried Distillers' Grains"	New Haven	G 23. F 27.41	6. 10.93	14. 11.67
4689	The Hottelet Co., Milwaukee, Wis. "National Dried Distillers' Grains"	Varysburg	G 23. F 25.7	6. 9.21	14. 11.17
4786	The Hottelet Co., Milwaukee, Wis. "Hector Distillers' Dried Grains"	Cobleskill	G 30. F 31.2	10. 11.48	14. 8.47
4813	The Hottelet Co., Milwaukee, Wis. "Hector Distillers' Dried Grains"	Collins	G 30. F 32.4	10. 11.11	14. 8.71
4614	Husted Milling Co., Buffalo, N. Y. "Husted Distillers' Grains"	Potsdam	G 30. F 33.69	8. 12.50	11. 10.92
4678	Husted Milling Co., Buffalo, N. Y. "Husted Distillers' Grains"	Elba	G 30. F 33.6	8. 12.05	11. 10.90
4969	Merchants' Distilling Co., Terre Haute, Ind. "Merchants' High Grade Dairy Feed"	Fort Plain	G 30. F 30.5	11. 12.15	14. 10.12
4899	The J. M. Murphy Co., Buffalo, N. Y. "Chippewa Distillers' Grains"	Attica	G —— F 31.4	—— 13.57	—— 11.27
5101	The J. M. Murphy Co., Buffalo, N. Y. "Dried Distillers' Grains"	East Aurora	G —— F 30.3	—— 13.14	—— 12.30
4622	J. D. Page & Co., Syracuse, N. Y. "Pure Empire State Dairy Feed"	Ogdensburg	G 30. F 31.	8. 14.16	12. 12.22
4844	J. D. Page & Co., Syracuse, N. Y. "Empire State Dairy Feed"	Jamestown	G 29. F 31.8	12. 12.34	12. 10.43

* These letters indicate, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.
			Per ct.	*Per ct.*	*Per ct.*
	DRIED DISTILLERS' GRAINS (*continued*):				
4856	J. D. Page & Co., Syracuse, N. Y. "Pure Empire State Dairy Feed"	Pavilion	G* 30. F* 31.4	8. 13.	12. 11.03
4668	Traders & Producers Supply Co., Buffalo, N. Y. "Seneca Distillers' Grains"	Darien Center	G 28. F 27.10	8. 9.42	14. 9.85
4914	Traders & Producers Supply Co., Buffalo, N. Y. "Seneca Distillers' Grains" †	Tuscarora	G 22. F 25.1	5. 9.83	14. 8.42
5103	Traders & Producers Supply Co., Buffalo, N. Y. "Chippewa Distillers' Grains"	East Aurora	G 30. F 32.1	10. 13.76	14. 11.43
5005	United American Co., Louisville, Ky. "Corn U. A. Distillers' Aerated Grain"	Oneonta	G 28. F 26.3	9. 9.97	13. 7.66
	DRIED BREWERS' GRAINS:				
4723	Anheuser-Busch Brewing Ass'n, St. Louis, Mo. "Dried Brewers' Grains"	Binghamton	G 21. F 22.19	6. 6.71	18. 15.21
5099	Anheuser-Busch Brewing Ass'n, St. Louis Mo. "Dried Brewers' Grains"	West Winfield	G 21. F 26.	6. 7.51	18. 13.90
4954	Anheuser-Busch Brewing Ass'n, St. Louis, Mo. "Steam Dried Brewers' Grains"	Altamont	G 21. F 19.1	6. 6.80	18. 16.59
4756	Atlantic Export Co. of Wis., Chicago, Ill. "Dried Brewers' Grains'	Albany	G 24. F 32.7	5. 5.91	17. 12.36
5165	M. F. Baringer, Philadelphia, Pa. "Dried Brewers' Grains"	Washington-ville	G 25. F 28.	6. 7.21	15. 11.39
4637	Bartholomay Brewery Co., Rochester, N. Y. "Dried Brewers' Grains"	Fulton	G 18.40 F 15.6	6.11 4.81	24.76 19.59
5081	Donahue-Stratton Co., Milwaukee, Wis. "'Tomahawk' Brand Pure Dried Brewers' Grains"	Sauquoit	G 26. F 28.3	6. 6.64	14. 12.33

* These letters indicate, respectively, Guaranteed and Found.
† Contains dried distillers' grains, light oats, light barley, and grain screenings.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.
			Per ct.	*Per ct.*	*Per ct.*
	DRIED BREWERS' GRAINS (*continued*):				
5214	Donahue-Stratton Co., Milwaukee, Wis. "'Tomahawk' Brand Pure Dried Brewers' Grains"	Waverly	G* 26. F* 31.	6. 6.65	14. 11.45
4672	Farmers Feed Co., New York, N. Y. "Dried Brewers' Grains, 'Bull' Brand"	Darien Center	G 27.20 F 25.88	6.30 6.27	17.20 13.43
4807	Farmers Feed Co., New York, N. Y. "Dried Brewers' Grains, 'Bull' Brand"	Eden Center	G 27.20 F 30.6	6.30 7.51	17.20 10.59
4783	Farmers Feed Co., New York, N. Y. "'Bull' Brand Dried Brewers' Grains"	Troy	G 27.20 F 26.8	6.30 6.71	17.20 12.27
4715	Hoffman & Co., Syracuse, N. Y. "Brewers' Dry Grains"	Sanitaria Springs	G 23. F 29.6	5.10 7.43	15. 12.33
5031	The Hottelet Co., Milwaukee, Wis. "Holstein Dried Brewers' Grains"	Delhi	G 25. F 27.7	5. 6.85	17. 13.72
5407	M. A. Joshel, Geneva, Ill. "Pure Dried Brewers' Grains"	Albany	G 25. F 29.3	8. 6.78	15. 13.05
4967	Milwaukee Grains and Feed Co., Milwaukee, Wis. "Crown Brewers' Dried Grains"	Fort Plain	G 25. F 27.	5. 6.76	15. 14.25
5217	The Penna. Central Brewing Co., Scranton, Pa. "Dried Brewers' Grains"	Conklin	G 23.71 F 23.7	7.14 7.02	15.85 14.07
4958	M. G. Rankin & Co., Milwaukee, Wis. "Durham Dried Brewers' Grains"	Guilderland Center	G 26. F 27.5	6. 6.54	16. 12.49
5185	Rosekrans-Snyder Co., Philadelphia, Pa. "Pilsner Dried Brewers' Grains"	Walden	G 25. F 29.1	5. 6.63	18. 13.12
5414	Jos. Schlitz Brewing Co., Milwaukee, Wis. "Schlitz Purity Dried Grains"	Poughkeepsie	G 24. F 26.4	6. 6.74	16. 15.06

* These letters indicate, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.		Crude protein.	Crude fat.	Crude fiber.
				Per ct.	*Per ct.*	*Per ct.*
	CORN STARCH BY-PRODUCT, WITHOUT CORN BRAN:					
4850	Corn Products Refining Co., New York, N. Y. "Diamond Gluten Meal"	South Wales	G F	40. 44.8	1.5 1.25	4. 1.29
	CORN STARCH BY-PRODUCT, WITH CORN BRAN:					
4662	American Maize Products Co., New York, N. Y. "Cream of Corn Gluten Feed"	Attica	G* F*	23. 26.06	2.50 5.01	8.50 6.12
4748	American Maize-Products Co., Roby, Ind. "Cream of Corn Gluten Feed"	Syracuse	G F	23. 26.5	2.50 2.62	8.50 6.67
4889	American Maize-Products Co., Roby, Ind. "Cream of Corn Gluten Feed"	Fairport	G F	23. 30.4	2.50 3.21	8.50 6.52
4696	Clinton Sugar Refining Co., Clinton, Ia. "Clinton Gluten Feed"	Arcade	G F	20. 25.7	3. 4.60	8. 6.91
5102	Clinton Sugar Refining Co., Clinton, Ia. "Clinton Gluten Feed"	East Aurora	G F	20. 26.1	3. 3.95	8. 6.67
4712	Corn Products Refining Co., New York, N. Y. "Buffalo Gluten Feed"	Union	G F	23. 23.6	2.5 2.86	8.5 5.78
4779	Corn Products Refining Co., New York, N. Y. "Buffalo Gluten Feed"	Watervliet	G F	23. 28.0	2. 3.53	8.5 5.86
4822	Corn Products Refining Co., New York, N. Y. "Buffalo Gluten Feed"	Akron	G F	23. 26.8	2. 3.36	8.50 5.99
4724	Corn Products Refining Co., New York, N. Y. "Crescent Gluten Feed"	Binghamton	G F	23. 26.4	2. 3.24	8.5 5.81
4766	Corn Products Refining Co., New York, N. Y. "Globe Gluten Feed"	Rensselaer	G F	23. 24.9	2. 4.24	8.5 5.71
5426	Corn Products Refining Co., New York, N. Y. "Globe Gluten Feed"	Delhi	G F	23. 26.2	2.50 2.61	8.50 6.80

* These letters indicate, respectively, guaranteed and Found.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.
			Per ct.	*Per ct.*	*Per ct.*
	CORN STARCH BY-PRODUCT, WITH CORN BRAN (*continued*):				
4694	Corn Products Refining Co., New York, N. Y. "Queen Gluten Feed"	North Java	G* 20. F* 22.2	2. 3.38	8.5 8.20
4849	Corn Products Refining Co., New York, N. Y. "Queen Gluten Feed"	South Wales	G 20. F 23.	2. 3.60	8.5 6.85
5026	Douglas & Co., Cedar Rapids, Ia. "Cedar Rapids Gluten Feed"	Walton	G 20. F 24.	2. 3.86	8. 6.75
5119	Douglas & Co., Cedar Rapids, Ia. "Cedar Rapids Gluten Feed"	Olean	G 20. F 23.5	2. 3.29	8. 6.45
5328	Douglas & Co., Cedar Rapids, Ia. "Cedar Rapids Gluten Feed"	N. Collins	G 22. F 23.6	4. 3.97	8. 6.12
4674	J. C. Hubinger Bros., Keokuk, Ia. "K K K Gluten Feed"	Darien Center	G 23.50 F 20.6	2.40 4.76	7.50 6.45
4787	J. C. Hubinger Bros. Co., Keokuk, Ia. "K K K Gluten Feed"	Cobleskill	G 23.50 F 23.	2.40 5.14	7.50 6.53
4666	The Keever Starch Co., Columbus, O. "Keever Gluten Feed"†	Darien Center	G 22. F 19.8	4.50 3.42	7. 6.39
4848	Piel Bros. Starch Co., Indianapolis, Ind. "P. Bro. Gluten Feed"	Hamburg	G 21. F 23.5	2. 3.77	8. 8.05
4711	A. E. Staley Manufacturing Co., Decatur, Ill. "Staley's Gluten Feed"	Union	G 23. F 23.	2.50 3.06	12. 6.09
5014	Union Starch and Refining Co., Edinburg, Ind. "Union Gluten Feed"	Stamford	G 24. F 26.5	3. 4.26	6.30 6.57

* These letters indicate, respectively, Guaranteed and Found.
† Guaranteed and found artificially colored.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.
			Per ct.	*Per ct.*	*Per ct.*
	HOMINY FEEDS:				
5117	Amana Society, Amana, Ia. "Hominy Feed"	Olean	G* 10. F* 11.6	7. 8.31	5. 3.03
4661	American Hominy Co., Indianapolis, Ind. "Homco Feed"	Attica	G 9.50 F 10.47	7. 7.16	7. 4.72
4631	M. F. Baringer, Philadelphia, Pa. "Hominy Feed"	Mexico	G 9. F 9.88	6. 5.98	10. 1.78
4643	Beatrice Corn Mills, Lincoln, Neb. "Pure Hominy Feed (Kiln Dried)"	Central Square	G 10. F 11.81	8. 8.57	10. 4.85
4667	Buffalo Cereal Co., Buffalo, N. Y. "Bufceco Hominy Feed"	Darien Center	G 10. F 10.91	7. 8.53	4. 4.73
5215	East Waverly Milling Co., Waverly, N. Y. "Hominy Feed"	Waverly	G 9. F 11.2	6. 7.06	5. 3.30
4851	Elevator Milling Co., Springfield, Ill. "Ideal Hominy Feed, Kiln Dried"	Silver Springs	G 11.02 F 11.1	7.70 8.33	—— 4.53
5035	Empire Grain and Elevator Co., Binghamton, N. Y. "Pearl Hominy"	Sidney	G 10. F 10.4	7. 8.58	6. 4.77
3850	Evans Milling Co., Indianapolis, Ind. "Evans Hominy Feed"	Batavia	G 10. F 11.25	7.50 8.29	7. 5.05
4717	Evans Milling Co., Indianapolis, Ind. "Evans Hominy Feed"	Sanitaria Springs	G 10. F 11.4	7.50 7.96	7. 4.57
4685	O. L. Hunter & Co., Chicago, Ill. "Calumet Hominy Feed"	Batavia	G 8.5 F 10.8	7. 7.98	10. 4.61
4827	O. L. Hunter & Co., Chicago, Ill. "Calumet Hominy Feed"	Akron	G 8.5 F 11.2	7. 7.99	10. 3.97

* These letters indicate, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.
			Per ct.	*Per ct.*	*Per ct.*
	HOMINY FEEDS (*continued*):				
4749	Husted Milling Co., Buffalo, N. Y. "Yellow Hominy Feed"	Syracuse	G* 9. F* 10.6	6. 7.12	8. 3.09
4808	Chas. A. Krause Milling Co., Milwaukee, Wis. "Badger Hominy Meal"	Eden Center	G 9. F 11.8	6. 5.89	5. 4.92
5159	Chas. A. Krause Milling Co., Milwaukee, Wis. "Badger Hominy Feed"	Westtown	G 9. F 11.9	6. 7.04	5. 5.22
5220	Chas. A. Krause Milling Co., Milwaukee, Wis. "Badger Hominy Feed"	Candor	G 9. F 11.4	6. 7.33	5. 5.12
5154	Miner-Hillard Milling Co., Wilkes-Barre, Pa. "Choice Steam Cooked Hominy Feed"	Middletown	G 10. F 11.1	7.50 5.66	5. 3.39
4719	National Feed Co., St. Louis, Mo. "Pure Hominy Feed, Kiln Dried"	Sanitaria Springs	G 8.50 F 11.2	7. 8.18	10. 4.85
4708	The Patent Cereals Co., Geneva, N. Y. "Hominy Feed"	Binghamton	G 10. F 11.4	7. 9.11	5. 4.01
4763	The Quaker Oats Co., Chicago, Ill. "Yellow Hominy Feed"	Albany	G 9. F 10.8	4. 4.78	4. 2.06
4757	M. G. Rankin & Co., Milwaukee, Wis. "White Hominy Feed"	Albany	G 9. F 11.2	6. 8.55	5. 3.81
3868	The Standard Cereal Co., Chillicothe, O. "'Logan' Hominy Feed"	Brooklyn	G 9. F 9.1	7. 7.36	6. 3.68
4677	Suffern, Hunt & Co., Decatur, Ill. "Acme Hominy Feed"	Elba	G 9.30 F 10.40	7.10 9.08	10. 4.27
4706	Suffern, Hunt & Co., Decatur, Ill. "Acme Hominy Feed"	Binghamton	G 9.30 F 11.	7.10 9.04	10. 4.21

* These letters indicate, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.
			Per ct.	*Per ct.*	*Per ct.*
	HOMINY FEEDS (*continued*):				
5244	Suffern, Hunt & Co., Decatur, Ill. "Acme Hominy Feed"	Lisle	G* 9.30 F* 11.3	7.10 7.90	10. 4.10
5166	The Toledo Elevator Co., Indianapolis, Ind. "Hominy Feed"	Washingtonville	G 9.50 F 10.5	7. 7.04	7. 4.28
4682	U. S. Frumentum Co., Detroit, Mich. "Frumentum Hominy Feed"	Oakfield	G 9.50 F 11.2	8. 9.25	7. 4.88
5100	West Winfield Mills, West Winfield, N. Y. "Choice Fine Hominy"	West Winfield	G — F 8.8	— 6.93	— 3.28

* These letters indicate, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
			Per ct.	*Per ct.*	*Per ct.*	
	COMPOUNDED FEEDS:					
4767	Acme Milling Co., Olean, N. Y. "Acme Feed"	Albany	G* 7.	3.	9.	Made from corn, hominy, oat hulls and one-half of 1 per cent salt.
			F* 9.5	4.07	5.14	As certified.
5072	Acme Milling Co., Olean, N. Y. "Acme Feed"	West Chazy	G 7.	3.	9.	Made from corn, hominy, oat hulls and one-half of 1 per cent salt.
			F 9.3	4.82	4.99	As certified.
5114	Acme Milling Co., Inc., Olean, N. Y. "Acme Feed"	Allegany	G 7.	3.	9.	Corn, hominy, oat hulls and one-half of 1 per cent salt.
			F 9.1	4.66	5.11	As certified.
5115	Acme Milling Co., Inc., Olean, N. Y. "Acme Feed"	Olean	G 7.	3.	9.	Made from corn, hominy and oat hulls.
			F 9.8	3.81	4.54	As certified.
3875	J. & T. Adikes, Jamaica, N. Y. "Ground Feed"	Jamaica	G 8.75	3.	6.	Barley, corn and cob, corn, oats and oat hulls.
			F 9.1	3.23	5.83	Ground corn, ground corn cob, oats, oat hulls, ground buckwheat hulls, traces of barley.
4821	Akron Produce Co., Akron, N. Y. "Bowers Dairy Ration"	Akron	G 24.	6.	8.50	Gluten, distillers' grains, hominy, oil meal, cotton seed meal, wheat bran, wheat middlings and salt.
			F 24.5	6.05	7.94	As certified.

5085	Jos. A. Baumert, Antwerp, N. Y. "Feed"	Antwerp	G —	—	—	Cottonseed meal, distillers' grains, spring bran, standard middlings, corn meal and about 1 per cent salt.
			F 24.1	7.05	7.14	Cottonseed meal, dried distillers' grains, wheat bran, wheat middlings, corn meal, salt.
5075	The Beck Cereal Co., Detroit, Mich. "Royal Chop Feed"	Plattsburg	G 8.31	5.10	5.81	Made from ground corn, oat middlings, oat shorts and oat hulls.
			F 9.8	5.48	6.21	As certified.
5172	Belvidere Flouring Mill Co., Belvidere, N. J. "Horse Feed"	Stonebridge	G 8.22	2.40	11.	Corn, oats, rye or rye middlings.
			F 12.8	3.47	3.07	Ground corn and oats, rye bran, rye middlings.
4752	The J. W. Biles Co., Cincinnati, O. "Union Grains, Ubiko Biles Ready Dairy Ration"	Albany	G 24.	7.	9.	Fourex distillers' dried grains, choice cottonseed meal, old process linseed meal, white wheat middlings, winter wheat bran, hominy meal, barley malt sprouts, ½ per cent fine table salt and nothing else.
			F 25.9	7.01	7.87	As certified.
4817	The J. W. Biles Co., Cincinnati, O. "Union Grains Ubiko Biles Ready Dairy Ration"	North Collins	G 24.	7.	9.	Fourex distillers' dried grains, choice cottonseed meal, old process linseed meal, white wheat middlings, winter wheat bran, hominy meal, barley malt sprouts, a small per cent of fine table salt.
			F 24.7	6.97	8.62	As certified.
4639	The J. W. Biles Co., Cincinnati, O. "Ubiko Horse and Stock Feed"	Fulton	G 16.	6.	9.	Is composed entirely of wheat middlings, hominy meal, wheat bran, brewers' dried grains, old process linseed meal and nothing else.
			F 19.13	6.75	8.93	As certified.

* These letters indicate, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
			Per ct.	Per ct.	Per ct.	
	COMPOUNDED FEEDS (*continued*):					
4877	The J. W. Biles Co., Cincinnati, O. "Ubiko Horse and Stock Feed"	Pittsford	G* 16.	6.	9.	Wheat middlings, hominy meal, wheat bran, brewers' dried grains, old process linseed meal, and nothing else.
			F* 17.8	6.73	7.63	Wheat middlings, wheat bran, hominy feed, dried brewers' grains, linseed meal, salt.
4687	The Blatchford Calf Meal Factory, Waukegan, Ill. "Blatchford's Calf Meal"	Varysburg	G 25.	5.	5.	Locust bean meal, wheat flour, flaxseed, cottonseed meal, beans and lentils.
			F 24.4	4.98	6.25	Locust bean meal, wheat flour, flaxseed, cottonseed meal, ground beans and lentils, ground cocoa shells, fenugreek.
4733	The Blatchford Calf Meal Factory, Waukegan, Ill. "Blatchford's Calf Meal"	Syracuse	G 25.	5.	5.	Locust bean meal, wheat flour, flaxseed, cottonseed meal, ground beans and lentils.
			F 25.4	4.80	5.88	Locust bean meal, wheat flour, flaxseed, cottonseed meal, ground beans and lentils, ground cocoa shells, fenugreek.
4774	The Blatchford Calf Meal Factory, Waukegan, Ill. "Blatchford's Calf Meal"	Troy	G 25.	5.	5.	Locust bean meal, wheat flour, flaxseed, cottonseed meal, ground beans and lentils.
			F 24.8	4.80	6.38	Locust bean meal, wheat flour, flaxseed, cottonseed meal, ground beans and lentils, ground cocoa shells, fenugreek.

4801	The Blatchford Calf Meal Factory, Waukegan, Ill. "Blatchford's Calf Meal"	Buffalo	G	25.	5.	5.	Locust bean meal, wheat flour, flaxseed, cottonseed meal, ground beans and lentils.
			F	24.6	4.40	5.79	Locust bean meal, wheat flour, flaxseed, cottonseed meal, ground beans and lentils, fenugreek.
4977	The Blatchford Calf Meal Factory, Waukegan, Ill. "Blatchford's Calf Meal"	Amsterdam	G	24.	5.	6.	Locust bean meal, crushed flaxseed, wheat flour, ground beans and peas, oil meal, cocoa-nut meal, cocoa shells, recleaned cottonseed meal, fenugreek, salt.
			F	24.6	5.04	6.	As certified.
5079	The Blatchford Calf Meal Factory, Waukegan, Ill. "Blatchford's Calf Meal"	Deansboro	G	24.	5.	6.	Locust bean meal, unpressed flaxseed, wheat flour, ground beans and peas, oil meal, cocoa shells, cocoa-nut meal, recleaned cottonseed meal, fenugreek, dried milk and salt.
			F	23.9	5.20	7.28	As certified.
3853	S. W. Bowne Co., Brooklyn, N. Y. "Ground Feed"	Brooklyn	G	7.	3.	11.	Corn meal, hominy chops, oat hulls.
			F	9.2	3.63	3.77	Corn meal, hominy feed, light oats, oat hulls, chaff.
3852	J. D. Braue, Jordan, N. Y. "Braue's Mixed Feed"	New York	G	12.	4.	12.	Crushed oats, crushed corn and alfalfa meal.
			F	11.8	3.49	9.16	As certified.
3855	Brooklyn Elevator & Milling Co., Brooklyn, N. Y. "Bemco Stock Feed"	Brooklyn	G	9.	3.	8.	Corn, oats, barley, bran and oat hulls.
			F	9.4	4.15	5.59	Corn, oats, barley, oat bran, oat hulls.
4742	Buffalo Cereal Co., Buffalo, N. Y. "Bufceco Chop Feed"	Syracuse	G	7.	3.	9.	Corn, hominy feed, oat bran, oat hulls.
			F	8.4	3.53	11.08	Corn, hominy feed, oat bran, oat hulls, screenings containing weed seeds.

* These letters indicate, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
			Per ct.	*Per ct.*	*Per ct.*	
	COMPOUNDED FEEDS (*continued*):					
4970	Buffalo Cereal Co., Buffalo, N. Y. "Bufceco Chop Feed"	Canajoharie	G* 7.	3.	9.	Corn, hominy feed, oat bran, oat hulls.
			F* 9.4	4.38	10.44	Corn, hominy feed, oat bran, oat hulls, screenings containing weed seeds.
5126	Buffalo Cereal Co., Buffalo, N. Y. "Bufceco Chop Feed"	Alden	G 7.	3.	9.	Corn, hominy feed, oat bran, oat hulls.
			F 9.1	4.05	10.33	Corn, hominy feed, oat bran, oat hulls, containing a few weed seeds.
5130	Buffalo Cereal Co., Buffalo, N. Y. "Bufceco Dairy Feed"	Williamsville	G 12.	3.	8.	Corn, wheat middlings, hominy feed, gluten feed, oat hulls.
			F 12.7	5.07	9.26	Corn, wheat bran, wheat middlings, hominy feed, oat hulls, cornstarch by-product with corn bran.
4741	Buffalo Cereal Co., Buffalo, N. Y. "Bufceco Horse Feed"	Syracuse	G 10.	4.	8.	Oats, corn, barley, gluten feed, wheat middlings, hominy feed, ground oats, oat hulls, oat bran, oat middlings.
			F 12.6	4.94	8.29	Oats, corn, feed barley, cornstarch by-product with corn bran, wheat middlings, hominy feed, linseed meal, oat middlings, oat shorts, oat hulls, salt. Contains some weed seeds.
4797	Buffalo Cereal Co., Buffalo, N. Y. "Bufceco Horse Feed"	Cherry Valley	G 10.	4.	8.	Oats, corn, barley, gluten feed, wheat middlings, hominy feed, ground oats, oat hulls, oat bran, oat middlings.
			F 11.	4.27	8.81	Oats, corn, cornstarch by-product with corn bran, wheat middlings, hominy feed, linseed meal, oat middlings, oat shorts, oat hulls.

5055	Buffalo Cereal Co., Buffalo, N. Y. "Bufceco Horse Feed"	Utica	G	10.	4.	8.	Oats, corn, barley, gluten feed, wheat middlings, hominy feed, ground oats, oat hulls, oat bran, oat middlings.
			F	11.7	4.18	8.85	Oats, corn, cornstarch by-product with corn bran, wheat middlings, hominy feed, linseed meal, oat middlings, oat shorts, oat hulls, salt.
5132	Buffalo Cereal Co., Buffalo, N. Y. "Bufceco Horse Feed"	Buffalo	G	10.	4.	8.	Made from oats, corn, barley, gluten feed, wheat middlings, hominy feed, ground oats, oat hulls, oat bran, oat middlings.
			F	11.4	4.21	8.81	Oats, corn, feed barley, cornstarch by-product with wheat bran, wheat middlings, hominy feed, linseed meal, oat middlings, oat shorts, oat hulls, salt. Contains some weed seeds.
4788	Buffalo Cereal Co., Buffalo, N. Y. "Bufceco Stock Feed"	Middleburg	G	8.	4.	9.	Corn, hominy feed, oat hulls, oat bran, gluten feed.
			F	8.2	4.19	8.86	Corn meal, hominy feed, oat bran, oat hulls.
5009	Buffalo Cereal Co., Buffalo, N. Y. "Bufceco Stock Feed"	Oneonta	G	8.	4.	9.	Corn, hominy feed, oat hulls, oat bran, gluten feed.
			F	7.9	5.12	9.77	Corn meal, hominy feed, oat bran, oat hulls.
5125	Buffalo Cereal Co., Buffalo, N. Y. "Bufceco Stock Feed"	Alden	G	8.	4.	9.	Corn, hominy feed, oat hulls, oat bran, gluten feed.
			F	8.7	4.93	8.93	Corn meal, hominy feed, oat bran, oat hulls.
5127	Buffalo Cereal Co., Buffalo, N. Y. "Iroquois Chop Feed"	Alden	G	7.	3.	9.	Ground corn, hominy feed, oat bran, oat hulls.
			F	9.1	4.73	9.44	As certified.

* These letters indicate, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
			Per ct.	Per ct.	Per ct.	
	COMPOUNDED FEEDS (*continued*):					
5168	Buffalo Cereal Co., Buffalo, N. Y. "Iroquois Chop Feed"	Washingtonville	G* 7.	3.	9.	Ground corn, hominy feed, oat bran, oat hulls.
			F* 9.2	4.25	7.13	As certified.
5452	Buffalo Cereal Co., Buffalo, N. Y. "Bufceco Creamery Feed"	Buffalo	G 18.	4.	8.	Corn, wheat middlings, hominy feed, cottonseed meal, gluten feed, oat hulls.
			F 19.1	5.35	9.35	Corn, wheat bran, wheat middlings, hominy feed, cottonseed meal, cornstarch by-product with corn bran, oat hulls.
3887	Cairnsmuir Farm, New City, N. Y. "Cairnsmuir Horse Feed"	New City	G 12.	5.	5.50	Wheat middlings, ground rye, red dog flour, wheat bran, corn meal, crushed oats.
			F 13.3	4.33	5.05	As certified.
4620	Chapin & Co., Hammond, Ind. "Unicorn Dairy Ration"	Ogdensburg	G 26.	5.5	10.	Ajax flakes, corn distillers' grains, green diamond cottonseed meal, green diamond hominy meal, gluten feed, brewers' grains, barley feed, malt sprouts, pure wheat bran.
			F 27.44	6.18	9.06	As certified.
4700	Chapin & Co., Milwaukee, Wis. "Unicorn Dairy Ration"	Castile	G 26.	5.5	10.	Ajax flakes, corn distillers' grains, green diamond cottonseed meal, green diamond hominy feed, gluten feed, brewers' grains, barley feed, malt sprouts, pure wheat bran.
			F 26.6	5.95	8.78	Distillers' grains, cottonseed meal, hominy feed, cornstarch by-product with corn bran, brewers' grains, barley feed, malt sprouts, wheat bran.

4838	Chapin & Co., Milwaukee, Wis. "Unicorn Dairy Ration"	Randolph	G	26.	5.5	10.	Ajax flakes, corn distillers' grains, green diamond cottonseed meal, green diamond hominy feed, gluten feed, brewers' grains, barley feed, malt sprouts, pure wheat bran.
			F	26.3	6.76	7.87	As certified.
5352	Chapin & Co., Milwaukee, Wis. "Acorn Dairy Ration"	Newport	G	26.	5.5	10.	Distillers' feed, green diamond cotton seed meal, green diamond hominy, wheat or corn gluten feed, barley feed and sprouts, pure wheat bran.
			F	27.1	7.76	9.14	Dried distillers' grains, cottonseed meal, hominy feed, cornstarch biproduct with corn bran, feed barley, malt sprouts, wheat bran.
4659	Chesbro Bros., Attica, N. Y. "Mixed Feed 'E'"	Attica	G	23.	6.	10.	Distillers' feed, oil meal, corn meal, cottonseed meal, gluten meal, bran, middlings.
			F	23.31	6.18	8.71	Dried distillers' grains, linseed meal, corn meal, cottonseed meal, cornstarch by-product with corn bran, wheat bran, wheat middlings, salt.
4641	Chesbro Milling Co., Salamanca, N. Y. "Chesbro's Stock Feed"	Oswego	G	10.	3.25	9.	Made from corn, barley, cottonseed meal, red dog flour, oat shorts, oat midds, oat hulls, one-half of 1 per cent salt.
			F	10.	6.27	10.32	As certified.
4664	Chesbro Milling Co., Salamanca, N. Y. "Chesbro's Stock Feed"	Attica	G	10.	3.25	9.	Corn, barley, cottonseed meal, red dog flour, oat shorts, oat midds, oat hulls, one-half of 1 per cent salt.
			F	10.85	5.43	9.33	As certified.
4750	Chesbro Milling Co., Salamanca, N. Y. "Chesbro's Stock Feed"	Syracuse	G	10.	3.25	9.	Corn, barley, cottonseed meal, red dog flour, oat shorts, oat midds, oat hulls, one-half of 1 per cent salt.
			F	10.2	5.40	10.67	As certified.

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ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
			Per ct.	*Per ct.*	*Per ct.*	
	COMPOUNDED FEEDS (*continued*):					
4973	Chesbro Milling Co., Salamanca, N. Y. "Chesbro's Stock Feed"	Canajoharie	G* 10.	3.25	9.	Corn, barley, cottonseed meal, red dog flour, oat shorts, oat midds, oat hulls, one-half of 1 per cent salt.
			F* 9.9	5.47	10.93	As certified.
5105	Chesbro Milling Co., Salamanca, N. Y. "Chesbro's Stock Feed"	Chaffee	G 10.	3.25	9.	Corn, barley, cottonseed meal, red dog flour, oat shorts, oat midds, oat hulls, one-half of 1 per cent salt.
			F 9.9	4.62	9.84	As certified.
4901	Chesbro Milling Co., Salamanca, N. Y. "Peerless Dairy Feed"	Avon	G 24.	7.	9.	Brewers' grains, cottonseed meal, oil meal, bran, middlings, malt sprouts, hominy.
			F 21.9	6.57	7.59	Dried brewers' grains, cottonseed meal, wheat bran, wheat middlings, malt sprouts, hominy feed, dried distillers' grains, corn meal.
5198	Chesbro Milling Co., Salamanca, N. Y. "Peerless Dairy Feed"	Cambridge	G 24.	7.	9.	Brewers' grains, cottonseed meal, oil meal, bran, middlings, malt sprouts, hominy.
			F 26.8	6.50	7.32	Dried brewers' grains, linseed meal, wheat bran, wheat middlings, malt sprouts, hominy feed, dried distillers' grains, cornstarch by-product without corn bran.

5247	Chesbro Milling Co., Salamanca, N. Y. "Peerless Dairy Feed"	Weedsport	G	24.	7.	9.	Brewers' grains, cottonseed meal, oil meal, bran, middlings, malt sprouts, hominy.
			F	22.3	6.74	8.17	Dried brewers' grains, cottonseed meal, wheat bran, wheat middlings, malt sprouts, hominy feed, dried distillers' grains, small amount corn meal.
5326	Chesbro Milling Co., Salamanca, N. Y. "Peerless Dairy Feed"	No. Collins	G	24.	7.	9.	Made from brewers' grains, cottonseed meal, oil meal, bran, middlings, malt sprouts, hominy.
			F	26.5	7.94	8.12	Dried brewers' grains, cottonseed meal, wheat bran, wheat middlings, malt sprouts, hominy feed, dried distillers' grains, corn meal.
4648	Chesbro Milling Co., Salamanca, N. Y. "Trojan Feed"	Watertown	G	7.	3.	12.	Made from corn, barley, oat shorts, oat midds and oat hulls, one-half of 1 per cent salt.
			F	9.01	5.87	10.87	As certified.
4665	Chesbro Milling Co., Salamanca, N. Y. "Trojan Feed"	Attica	G	7.	3.	12.	Corn, barley, oat shorts, oat midds and oat hulls, one-half of 1 per cent salt.
			F	10.10	5.31	8.83	As certified.
4770	Chesbro Milling Co., Salamanca, N. Y. "Trojan Feed"	Albany	G	7.	3.	12.	Corn, barley, oat shorts, oat middlings and oat hulls, one-half of 1 per cent. salt.
			F	8.7	5.	11.25	Cracked corn, feed barley, oat shorts, oat middlings, oat hulls, salt.
5076	Clinton Milling and Grain Co., Plattsburg, N. Y. "Derby Feed"	Plattsburg	G	7.5	2.95	11.24	Corn, oats, ground corn cob, oat hulls.
			F	8.6	2.94	11.83	As certified.
5052	Commercial Milling Co., Detroit, Mich. "Henkel's Coarse Brown Feed"	Adams	G	15.	4.	8.	Made from wheat and buckwheat middlings, white corn and rye middlings.
			F	16.5	5.43	6.54	As certified.

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ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.		Crude protein.	Crude fat.	Crude fiber.	Ingredients.
				Per ct.	Per ct.	Per ct.	
	COMPOUNDED FEEDS (*continued*):						
5069	Commercial Milling Co., Detroit, Mich. "Henkel's Fine White Feed"	Malone Junction	G*	15.	3.5	4.	From natural wheat run and buckwheat middlings, white corn and rye middlings.
			F*	15.8	4.22	4.63	Wheat middlings, buckwheat middlings, rye middlings, corn meal.
5240	Commercial Milling Co., Detroit, Mich. "Henkel's Chop Feed"	Binghamton	G	8.	5.	8.	Corn meal, wheat and oat middlings, oats and oat hulls.
			F	9.3	4.7	4.58	Corn meal, corn offal, ground wheat, oats, oat bran, oat hulls.
3889	W. H. Coonrod, Port Jervis, N. Y. "Horse Feed"	Port Jervis	G	9.	3.	14.	Ground corn, corn bran, ground oats, wheat and rye middlings, oat meal mill by-products (oat hulls and oat middlings), Star feed (hominy feed and ground corn cob), wheat flour, and one-half of 1 per cent salt.
			F	9.7	4.05	6.45	Ground corn, hominy feed, ground corn cob, ground oats, oat middlings, oat hulls, wheat middlings, rye middlings.
3874	The Corno Mills Co., St. Louis, Mo. "Corno Horse and Mule Feed"	New York	G	10.	3.5	12.	Ground alfalfa, ground corn, cottonseed meal, hominy feed, oat hulls and oat middlings.
			F	10.1	4.04	11.99	Alfalfa meal, cracked corn, cottonseed meal, hominy feed, oat middlings, oat hulls.
4883	Corn Products Refining Co., New York, N. Y. "Diamond Hog Meal"	Rochester	G	18.	8.	13.	Corn and bone meal.
			F	16.2	8.69	9.79	Ground corn oil cake, charred bone.

5033	Crawford Brothers, Walton, N. Y. "Crawford's Stock Feed"	Walton	G	10.	4.	12.	Ground corn, hominy feed, corn germ meal, oat hulls, wheat bran and wheat middlings.
			F	11.5	6.43	9.22	As certified.
3885	Crow & Williams, Ossining, N. Y. "Mixed Feed"	Ossining	G	8.	3.	12.	Corn, hominy, wheat bran, light oats, wheat middlings.
			F	9.7	3.29	8.58	Ground corn, hominy feed, oats, light oats, oat hulls, wheat middlings, cottonseed meal.
4790	Albert Dickinson Co., Chicago, Ill. "White Cross Stock Feed"	Middleburg	G	10.	3.5	10.	Ground oats, ground barley, corn feed meal, wheat meal, ground corn bran, cottonseed meal, salt one-half of 1 per cent.
			F	10.	3.57	2.97	As certified.
5007	The Albert Dickinson Co., Chicago, Ill. "White Cross Stock Feed"	Oneonta	G	10.	3.5	10.	Ground oats, ground barley, corn feed meal, wheat meal, ground corn bran, cottonseed meal, salt one-half of 1 per cent.
			F	9.6	3.92	3.58	As certified.
5071	Dock and Coal Co., Plattsburg, N. Y. "Dandy Feed"	Chasy	G	8.	5.	8.	Corn meal, wheat and oat middlings, oats and oat hulls.
			F	9.	4.31	6.61	As certified.
5077	Geo. F. Dudley & Co., Ticonderoga, N. Y. "Cow Feed"	Ticonderoga	G	—	—	—	Bran, cottonseed meal, middlings, corn and oats.
			F	21.53	5.49	8.21	As certified.
5164	Duluth-Superior Mfg. Co., Duluth, Minn. "Boston Mixed Feed"	Monroe	G	16.	4.	8.	Wheat bran, middlings and low grade flour.
			F	16.	5.84	8.08	As certified.

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ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
			Per ct.	*Per ct.*	*Per ct.*	
	COMPOUNDED FEEDS (*continued*):					
4978	R. D. Eaton Grain and Feed Co., Norwich, N. Y. "Eaton's Special Dairy Feed"	Schenectady	G* 12.	3.	12.	Alfalfa meal, oil meal, pea meal, brewers' grains, corn meal, cottonseed meal, oats and barley.
			F* 12.4	3.81	9.39	Alfalfa meal, pea meal, linseed meal, corn meal, ground oats, ground barley, cottonseed meal, kaffir meal.
5038	R. D. Eaton Grain and Feed Co., Norwich, N. Y. "Eaton's Special Dairy Feed"	Norwich	G 12.	3.	12.	Alfalfa meal, oil meal, pea meal, brewers' grains, corn meal, cottonseed meal, oats and barley.
			F 12.7	4.26	9.58	Alfalfa meal, pea meal, linseed meal, corn meal, cottonseed meal, ground oats, ground barley, kaffir meal.
5003	Elmore Milling Co., Oneonta, N. Y. "Corn and Oat Provender"	Oneonta	G 8.75	3.5	9.	Corn, ground oats, oat hulls, corn bran and salt.
			F 10.8	3.48	5.37	Corn, corn bran, corn chaff containing some cob, ground oats, oat hulls.
4953	Elmore Milling Co., Oneonta, N. Y. "Susquehanna Stock Feed"	Delanson	G 7.76	3.6	9.	Ground oats, corn meal, cob meal, corn bran.
			F 9.	3.31	5.44	As certified.
5002	Elmore Milling Co., Oneonta, N. Y. "Susquehanna Stock Feed"	Oneonta	G 7.76	3.6	9.	Ground oats, corn meal, cob meal, corn bran.
			F 8.4	3.62	7.06	As certified.

5230	Empire Grain & Elevator Co., Binghamton, N. Y. "Neverfail Dairy Feed"	Binghamton	G	25.	6.	9.	Cottonseed meal, distillers' grains, linseed meal, gluten meal, brewers' grains, corn meal, barley malt sprouts, wheat bran, salt not to exceed three-fourths of 1 per cent.
			F	22.9	5.66	9.04	Cottonseed meal, dried distillers' grains, linseed meal, cornstarch by-product with corn bran, dried brewers' grains, corn meal, malt sprouts, wheat bran, screenings consisting largely of weed seeds, salt.
5110	The Empire Mfg. Co., Franklinville, N. Y. "Empire Stock Feed"	Franklinville	G	20.	3.	8.	Malt sprouts, wheat bran, corn, gluten, oil meal, distillers' grains.
			F	20.1	3.4	7.10	Malt sprouts, wheat bran, corn, cornstarch by-product with corn bran, linseed meal.
5196	Empire Mill & Coal Co., Schaghticoke, N. Y. "Empire Milk Producer"	Schaghticoke	G	14.5	2.4	10.5	Corn meal, wheat bran, malt sprouts, beet pulp, wheat middlings, rye middlings, cottonseed meal, screenings, mill sweepings, fine salt.
			F	16.6	4.11	12.47	Small amount of corn meal, wheat bran, wheat middlings, rye middlings, cottonseed meal, cottonseed hulls, pea meal, mill screenings and sweepings, salt.
4795	Empire Mills, Olean, N. Y. "Empire Feed"	Richmondville	G	7.5	3.	9.	Corn, hominy, oat hulls.
			F	8.9	4.86	5.71	As certified.
5207	Empire Mills, Olean, N. Y. "Empire Feed"	Corning	G	7.5	3.	9.	Corn, hominy, oat hulls.
			F	9.3	4.57	6.56	As certified.

* These letters indicate, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
			Per ct.	*Per ct.*	*Per ct.*	
	COMPOUNDED FEEDS (*continued*):					
4987	Everett & Treadwell Co., Kingston, N. Y. "C. O. & W. Feed"	Kingston	G* 11.5	3.5	——	Ground corn, corn bran, ground oats, ground rye or wheat middlings.
			F* 11.7	3.71	5.12	Ground corn, corn bran, ground oats, rye middlings.
3121	Felt Bros. & Gage Co., Inc., Olean, N. Y. "Empire Feed"	Olean	G 7.5	3.	9.	Composed of corn, hominy, oat hulls.
			F 8.6	3.29	7.14	As certified.
4730	General Flour & Feed Co., Buffalo, N. Y. "Big 4 Chop Feed"	Syracuse	G 7.	3.	12.	Cracked corn, corn and cob meal, ground oat hulls, oat middlings, corn bran.
			F 8.8	5.1	11.98	Cracked corn, corn meal, ground corn cob, oat hulls, oat middlings, corn bran.
4729	General Flour & Feed Co., Buffalo, N. Y. "Honest Cow Feed"	Syracuse	G 24.	6.	9.	Distillers' grains, gluten, wheat middlings, corn meal, wheat bran, 1½ per cent salt, corn bran, cottonseed meal, and oil meal.
			F 25.9	6.23	6.81	Dried distillers' grains, cornstarch by-product with corn bran, wheat middlings, corn meal, wheat bran, corn bran, cottonseed meal, linseed meal, salt.
5143	General Flour & Feed Co., Buffalo, N. Y. "Honest Cow Feed"	Buffalo	G 24.	6.	9.	Distillers' grains, gluten, wheat middlings, corn meal, wheat bran, 1½ per cent salt, corn bran, cottonseed meal and oil meal.
			F 24.8	7.18	8.1	Dried distillers' grains, cornstarch by-product with corn bran, wheat middlings, corn bran, corn meal, wheat bran, cottonseed meal, linseed meal, salt.

4734	General Flour & Feed Co., Syracuse, N. Y. "Standard M & S"	Syracuse	G 10.	3.	10.	Wheat bran, "B" meal which is composed of corn and cob meal, the amount of cob used being the same as though ear corn was ground cob and all.
			F 10.9	3.31	6.98	As certified.
4747	Gilbert & Nichols Co., Fulton, N. Y. "Fulton Dairy Feed"	Syracuse	G 26.	6.	9.	Distillers' grains, malt sprouts, brewers' grains, cottonseed meal, old process oil meal, buckwheat middlings, gluten feed, wheat bran, corn meal, mixed with a very small quantity of salt.
			F 31.1	5.86	6.09	Dried distillers' grains, malt sprouts, brewers' grains, cottonseed meal, linseed meal, buckwheat middlings, buckwheat hulls, cornstarch by-product with corn bran, wheat bran, corn meal, salt.
5089	Gilbert & Nichols Co., Fulton, N. Y. "Fulton Dairy Feed"	Fulton	G 26.	6.	9.	Distillers' grains, malt sprouts, brewers' grains, cottonseed meal, old process oil meal, buckwheat middlings, gluten feed, wheat bran, corn meal, mixed with a small quantity of salt.
			F 25.6	5.88	8.58	Dried distillers' grains, malt sprouts, dried brewers' grains, cottonseed meal, linseed meal, buckwheat middlings, buckwheat hulls, cornstarch by-product with corn bran, wheat bran, corn meal, salt.
3884	Globe Elevator Co., Buffalo, N. Y. "No. 1 Chop Feed"	Peekskill	G 7.	3.	12.	Ground corn and oats and oat hulls, flour middlings, salt one-half of 1 per cent.
			F 8.1	3.06	8.55	Ground corn, ground oats, oat hulls, wheat middlings, salt.

* These letters indicate, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
			Per ct.	*Per ct.*	*Per ct.*	
	COMPOUNDED FEEDS (*continued*):					
4880	Globe Elevator Co., Buffalo, N. Y. "No. 1 Chop Feed"	Gates	G* 7.	3.	12.	Ground corn and oats and oat hulls, flour middlings, salt one-half of 1 per cent.
			F* 10.3	3.22	3.14	Corn, oats and wheat ground, wheat middlings, oat hulls, salt.
5131	Globe Elevator Co., Buffalo, N. Y. "No. 1 Chop Feed"	Buffalo	G 7.	3.	9.	Made from ground corn and oats and oat hulls, flour middlings, salt one-half of 1 per cent.
			F 10.	4.63	4.99	Oats, ground corn, wheat, oat hulls, wheat middlings, salt.
5194	Globe Elevator Co., Buffalo, N. Y. "No. 1 Chop Feed"	Nassau	G 7.	3.	12.	Ground corn and oats and oat hulls, flour middlings, salt one-half of 1 per cent.
			F 11.3	4.19	5.95	Corn, wheat and oats, ground, oat hulls, wheat middlings, salt.
5091	Globe Elevator Co., Buffalo, N. Y. "Stone Mills Mixed Feed"	Remsen	G 11.	5.	9.	Made from wheat bran, wheat flour and middlings, ground wheat screenings, corn bran and salt one-half of 1 per cent.
			F 12.4	3.73	6.08	As certified.
5129	Globe Elevator Co., Buffalo, N. Y. "Stone Mills Horse Feed"	Alden	G 7.	3.	9.	Corn, oats, oat hulls, oat shorts, wheat flour, hominy and three-fourths of 1 per cent salt.
			F 10.5	3.18	3.93	Corn, corn bran, wheat, oats, oat shorts, oat hulls, hominy feed, wheat flour, salt.

5228	Globe Elevator Co., Buffalo, N. Y. "Stone Mills Horse Feed"	Lestershire	G	7.	3.	9.	Corn, oats, oat hulls, oat shorts, wheat flour, hominy and salt three-fourths of 1 per cent.
			F	10.4	3.3	3.7	Corn, corn bran, wheat, oats, oat shorts, oat hulls, hominy feed, wheat flour, salt.
5317	J. Gorman, Buffalo, N. Y. "Boat Sweepings"	Buffalo	G	5.	2.	14.	This commodity is composed of sweepings from boats loaded with flour and feed, and consists of several materials having feeding stuffs value; but it is impossible to name each ingredient contained therein.
			F	18.	4.23	5.66	Wheat bran, wheat middlings, wheat flour, distillers' grains, brewers' grains, cornstarch by-product with corn bran, rolled oats.
4693	D. H. Grandin Milling Co., Jamestown, N. Y. "Grandin's Stock Food"	North Java	G	8.5	3.5	8.	Pure oats, corn, barley, barley middlings, hominy feed, oat hulls and salt.
			F	10.3	7.81	7.75	As certified.
4837	D. H. Grandin Milling Co., Jamestown, N. Y. "Grandin's Stock Feed"	Randolph	G	8.5	3.5	9.	Pure oats, corn, barley, barley middlings, hominy feed, oat hulls and salt.
			F	10.2	6.79	7.37	As certified.
4847	D. H. Grandin Milling Co., Jamestown, N. Y. "Grandin's Stock Feed"	Conewango	G	8.5	3.5	9.	Pure oats, corn, barley, barley middlings, hominy feed, oat hulls and salt.
			F	9.5	6.58	8.16	As certified.
5051	D. H. Grandin Milling Co., Jamestown, N. Y. "Grandin's Stock Food"	Adams	G	8.5	3.5	9.	Pure oats, corn, barley, barley middlings, hominy feed, oat hulls and salt.
			F	10.1	4.85	9.62	As certified.
4829	D. H. Grandin Milling Co., Jamestown, N. Y. "Ta-Ko Stock Feed"	Jamestown	G	7.5	3.	10.	Made from pure ground oats, corn meal, ground barley, oat hulls and salt.
			F	8.1	3.08	8.24	Ground oats, light oats, ground barley, light barley, corn meal, oat hulls, chaff, salt.

* These letters indicate, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.		Crude protein.	Crude fat.	Crude fiber.	Ingredients.
				Per ct.	*Per ct.*	*Per ct.*	
	COMPOUNDED FEEDS (*continued*):						
5209	Estate of S. T. Hayt, Corning, N. Y.	Corning	G	8.	3.	8.	Corn, oats, bran, midds, oat hulls and oat middlings.
	"Algood Chop Feed"		F	10.3	4.06	3.83	As certified.
5316	Henry & Missert, Buffalo, N. Y.	Buffalo	G	15.75	3.02	11.23	Barley malt and by-product.
	"Malt Feed"		F	14.7	2.6	11.48	As certified.
4853	Henry & Missert, Buffalo, N. Y.	Perry	G	26.	7.	16.	Corn distillers' grains, cottonseed meal, ground barley malt and sprouts.
	"Matchless Complete Ratio Dairy Feed"		F	26.6	5.9	8.86	Distillers' grains, cottonseed meal, malt sprouts, salt.
5303	Henry & Missert, Buffalo, N. Y.	Buffalo	G	26.	7.	16.	Corn distillers' grains, cottonseed meal, ground barley malt and sprouts.
	"Matchless Complete Ratio Dairy Feed"		F	26.6	7.08	10.44	Distillers' grains, cottonseed meal, malt sprouts, salt.
4911	Henry & Missert, Buffalo, N. Y.	Spencerport	G	9.8	2.75	16.	Wheat bran, ground corn, cob meal.
	"S-Bran Sterling Feed"		F	9.69	3.31	14.96	Wheat bran, cracked corn, ground corn cob.
5088	A. H. Herrick & Son, Watertown, N. Y.	Watertown	G	22.31	6.69	6.77	Oil meal, corn meal, winter wheat bran, midds, alfalfa meal, beef scrap.
	"Herrick's Quality Soft Feed"		F	22.4	5.92	5.53	Linseed meal, corn meal, wheat bran, wheat middlings, alfalfa meal, beef scrap.
5208	Hodgman Milling Co., Painted Post, N. Y.	Painted Post	G	9.69	3.88	——	Corn, oats, barley and oat skimmings, oat middlings and oat hulls.
	"Chop Feed"		F	9.9	3.7	4.94	As certified.

5453	The H-O Co., Buffalo, N. Y. "De-Fi Feed"	Buffalo	G	8.	3.	21.	Oat hulls, oat bran, corn, hominy feed, wheat middlings, oat middlings, salt.
			F	8.6	3.85	13.98	As certified.
3869	The H-O Co., Buffalo, N. Y. "The H-O Co's Algrane Milk Feed"	Brooklyn	G	14.	4.	9.	Oat hulls, wheat middlings, cottonseed meal, oat bran, gluten, corn, oats, salt.
			F	18.9	5.13	9.73	Corn, oats, oat bran, oat hulls, wheat middlings, cottonseed meal, cornstarch by-product with corn bran.
4863	The H-O Co., Buffalo, N. Y. "The H.O Co.'s Algrane Milk Feed"	Canandaigua	G	14.	4.	9.	Oat hulls, wheat middlings, cottonseed meal, oat bran, gluten, corn, oats, salt.
			F	18.2	4.69	10.03	Cornstarch by-product with corn bran, cottonseed meal, wheat middlings, oat middlings, corn meal, wheat, oats, salt.
5455	The H-O Co., Buffalo, N. Y. "The H-O Co.'s Algrane Milk Feed"	Buffalo	G	14.	4.	9.	Oat hulls, wheat middlings, cottonseed meal, oat bran, gluten, corn, oats, salt.
			F	19.5	5.	9.81	Oat hulls, wheat middlings, cottonseed meal, oat bran, oat middlings, cornstarch by-product with corn bran, corn, salt.
4736	The H-O Co., Buffalo, N. Y. "The H-O Co.'s Algrane Horse Feed"	Syracuse	G	11.	4.	9.	Oats, oat hulls, gluten feed, oat bran, wheat middlings, corn, hominy feed, salt one-half of 1 per cent.
			F	11.7	4.53	11.26	Oats, oat hulls, cornstarch by-product with corn bran, oat shorts, wheat middlings, ground corn, hominy feed, salt.
4771	The H-O Co., Buffalo, N. Y. "The H-O Co.'s Algrane Horse Feed"	Troy	G	11.	4.	9.	Oats, oat hulls, gluten feed, oat bran, wheat middlings, corn, hominy feed, salt one-half of 1 per cent.
			F	11.7	3.92	9.53	Oats, oat hulls, cornstarch by-product with corn bran, oat bran, wheat middlings, corn, hominy feed, salt.

* These letters indicate, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
			Per ct.	*Per ct.*	*Per ct.*	
	COMPOUNDED FEEDS (*continued*):					
4861	The H-O Co., Buffalo, N. Y. "The H-O Co.'s Algrane Horse Feed"	Canandaigua	G* 11.	4.	9.	Oats, oat hulls, gluten feed, oat shorts, wheat middlings, ground corn, hominy feed, salt one-half of 1 per cent.
			F* 11.4	4.1	11.2	Oats, oat hulls, cornstarch by-product with corn bran, oat shorts, wheat middlings, ground corn, hominy feed.
5140	The H-O Co., Buffalo, N. Y. "The H-O Co.'s Algrane Horse Feed"	Tonawanda	G 11.	4.	9.	Oats, oat hulls, gluten feed, oat bran, wheat middlings, corn, hominy feed, salt one-half of 1 per cent.
			F 12.1	4.42	10.22	Oats, oat hulls, cornstarch by-product with corn bran, oat shorts, wheat middlings, ground corn, hominy feed, salt.
4862	The H-O Co., Buffalo, N. Y. "New England Stock Feed"	Canandaigua	G 9.	4.	9.	Corn, oat bran, hominy feed, oats, oat hulls, one-half of 1 per cent salt.
			F 10.5	4.94	8.79	As certified.
5139	The H-O Co., Buffalo, N. Y. "New England Stock Feed"	Tonawanda	G 9.	4.	9.	Corn, hominy feed, oat hulls, oat bran, oats, one-half of 1 per cent salt.
			F 9.6	1.97	7.95	As certified.
5173	The H-O Co., Buffalo, N. Y. "New England Stock Feed"	Chester	G 9.	4.	9.	Corn, oat bran, hominy feed, oats, oat hulls, one-half of 1 per cent salt.
			F 10.7	4.3	8.89	As certified.

4076	Husted Milling Co., Buffalo, N. Y. "Husted Dairy Feed"	Gloversville	C	20.	4.	9.	Cottonseed meal, corn meal, oat clips, wheat middlings, gluten feed, oil meal, distillers' grains, malt sprouts, salt three-fourths of 1 per cent.
			F	22.3	5.35	8.68	Cottonseed meal, corn meal, oat clippings and grain screenings, wheat middlings, cornstarch by-product with corn bran, linseed meal, distillers' grains, brewers' grains, malt sprouts, salt.
5016	Husted Milling Co., Buffalo, N. Y "Husted Dairy Feed"	Oneonta	G	20.	4.	9.	Cottonseed meal, corn meal, oat clips, wheat middlings, gluten feed, oil meal, distillers' grains, malt sprouts, salt three-fourths of 1 per cent.
			F	25.	4.72	7.55	Cottonseed meal, corn meal, oat clippings and grain screenings, wheat middlings, cornstarch by-product with corn bran, linseed meal, dried distillers' grains, malt sprouts, salt.
5335	Husted Milling Co., Buffalo, N. Y. "Husted Dairy Feed"	Buffalo	G	20.	4.	9.	Cottonseed meal, corn meal, oat clips, wheat middlings, gluten feed, oil meal, distillers' grains, malt sprouts, salt three-fourths of 1 per cent.
			F	20.4	4.62	7.32	Cottonseed meal, corn meal, oat clippings and grain screenings, wheat middlings, cornstarch by-product with corn bran, linseed meal, dried distillers' grains, dried brewers' grains, malt sprouts, salt.
4793	Husted Milling Co., Buffalo, N. Y. "Husted Horse Feed"	Richmondville	G	12.	4.	9.	Corn, oats, middlings, gluten, oat hulls, oil meal, salt three-fourths of 1 per cent.
			F	14.7	4.47	6.87	Cracked corn, corn meal, oats, oat hulls, wheat middlings, cornstarch by-product with corn bran, linseed meal, salt.

* These letters indicate, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
			Per ct.	*Per ct.*	*Per ct.*	
	COMPOUNDED FEEDS (*continued*):					
5336	Husted Milling Co., Buffalo, N. Y. "Husted Horse Feed"	Buffalo	G* 12.	4.	9.	Corn, oats, middlings, gluten, oat hulls, oil meal, salt three-fourths of 1 per cent.
			F* 12.2	4.43	6.75	Cracked corn, corn meal, oats, oat hulls, wheat middlings, cornstarch by-product with corn bran, linseed meal, salt.
5186	Husted Milling Co., Buffalo, N. Y. "Husted Stock Feed"	Stony Point	G 8.	4.	9.	Corn meal, hominy feed, oat hulls, wheat middlings, salt three-fourths of 1 per cent.
			F 11.5	5.58	7.81	As certified.
5348	Husted Milling Co., Buffalo, N. Y. "Husted Stock Feed"	Buffalo	G 8.	4.	9.	Corn, oats, oat hulls, hominy, middlings, salt three-fourths of 1 per cent.
			F 10.2	5.65	6.33	Corn, oats, oat middlings, oat hulls, hominy feed, salt.
5222	Husted Milling Co., Buffalo, N. Y. "Husted Yellow Provender"	Ithaca	G 7.	4.	9.	Corn, oats, yellow hominy, oat hulls, salt three-fourths of 1 per cent.
			F 9.5	4.15	4.54	As certified.
4675	Husted Milling Co., Buffalo, N. Y. "Mayflower Stock Feed"	Alexander	G 7.5	3.5	9.	Corn meal, whole oats, hominy feed, oat hulls, salt three-fourths of 1 per cent.
			F 10.52	5.01	6.13	Corn meal, oats, hominy feed, oat hulls, chaff, salt.
5349	Husted Milling Co., Buffalo, N. Y. "Mayflower Stock Feed"	Buffalo	G 7.5	3.5	9.	Corn, oats, oat hulls, salt three-fourths of 1 per cent.
			F 9.3	3.59	5.68	Corn, corn offal, oats, oat hulls, salt.

4671	Husted Milling Co., Buffalo, N. Y. "Monarch Chop Feed"	Darien Center	G	7.5	3.5	9.	Corn meal, whole oats, ground oats, oat hulls, hominy feed, salt three-fourths of 1 per cent.
			F	9.88	5.29	5.06	Corn meal, oats, hominy feed, oat hulls, chaff, salt.
4776	Husted Milling Co., Buffalo, N. Y. "Monarch Chop Feed"	Troy	G	7.5	3.5	9.	Corn meal, whole oats, ground oats, oat hulls, hominy feed, salt three-fourths of 1 per cent.
			F	9.7	4.93	6.39	Corn meal, oats, light oats, oat hulls, hominy feed, screenings, salt.
4803	Husted Milling Co., Buffalo, N. Y. "Monarch Chop Feed"	Buffalo	G	7.5	3.5	9.	Corn meal, whole oats, ground oats, hominy feed, salt three-fourths of 1 per cent, oat hulls.
			F	10.2	4.88	5.22	Corn meal, oats, light oats, hominy feed, oat hulls, screenings, salt.
5347	Husted Milling Co., Buffalo, N. Y. "Regal Chop"	Buffalo	G	7.	3.	9.	Whole oats, ground oats, cracked corn, corn meal, oat hulls, salt three-fourths of 1 per cent.
			F	7.9	3.13	8.13	As certified.
4792	Husted Milling Co., Buffalo, N. Y. "Zenith Stock Feed"	Richmondville	G	10.	4.	9.	Corn meal, whole barley, wheat middlings, oat hulls, salt three-fourths of 1 per cent.
			F	11.5	5.75	4.79	Corn meal, chaff, barley, wheat middlings, oat hulls, salt.
5350	Husted Milling Co., Buffalo, N. Y. "Zenith Stock Feed"	Buffalo	G	10.	4.	9.	Corn, oats, barley, oat hulls, middlings, salt three-fourths of 1 per cent.
			F	9.8	3.5	5.15	Corn, corn offal, oats, oat hulls, oat middlings, barley, salt.
5319	Hydraulic Milling Co., Buffalo, N. Y. "Hydraulic Milling Company's Standard Chop Feed"	Buffalo	G	6.44	2.53	6.	Corn meal, hominy, oat middlings, oat hulls, ground oats.
			F	10.4	4.74	4.34	Corn meal, hominy feed, oats, oat middlings, oat hulls, barley products, small amount of weed seeds.

* These letters indicate, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
			Per ct.	*Per ct.*	*Per ct.*	
	COMPOUNDED FEEDS (*continued*):					
4746	Indiana Milling Co., Terre Haute, Ind. "Sterling Feed"	Syracuse	G* 9.8	2.75	16.	Wheat bran, ground corn, cob meal.
			F* 9.6	2.99	16.96	As certified.
5056	Indiana Milling Co., Terre Haute, Ind. "Sterling Feed"	Clinton	G 9.8	2.75	16.	Wheat bran, ground corn, cob meal.
			F 9.6	3.36	17.45	As certified.
5148	Indiana Milling Co., Terre Haute, Ind. "Sterling Feed"	Little Valley	G 9.8	2.75	16.	Wheat bran, ground corn, cob meal.
			F 10.	3.37	15.86	As certified.
5178	Indiana Milling Co., Terre Haute, Ind. "Sterling Feed"	West Newburgh	G 9.8	2.75	16.	Wheat bran, ground corn, cob meal.
			F 9.6	2.98	16.07	As certified.
4647	International Stock Food Co., Minneapolis, Minn. "International Grofast Calf Meal"	Watertown	G 25.	5.	10.	Fenugreek seed, locust bean, linseed oil meal, dried brewers' grains, cottonseed meal, flaxseed, gluten feed, malt sprouts, pea meal, distillers' dried grains, cleaned grain screenings, red dog flour.
			F 25.75	5.83	8.24	Fenugreek, locust bean meal, linseed meal, ground flaxseed, pea meal, red dog flour, ground grain screenings.

5001	International Stock Food Co., Minneapolis, Minn. "International Grofast Calf Meal"	Syracuse	G	25.	5.	10.	Fenugreek seed, locust bean, linseed oil meal, dried brewers' grains, cottonseed meal, flaxseed, gluten feed, malt sprouts, pea meal, distillers' dried grains, cleaned grain screenings, red dog flour.
			F	24.6	5.89	8.35	Fenugreek, locust bean meal, linseed meal, ground flaxseed, pea meal, red dog flour, ground grain screenings.
4820	Jamestown Electric Mills, Jamestown, N. Y. "Jem Feed"	North Collins	G	8.5	3.	9.	Yellow corn meal — oats and oat feed.
			F	9.6	3.74	9.67	Corn meal, oats, oat middlings, oat hulls.
4690	Jamestown Electric Mills, Jamestown, N. Y. "Purity Milk Maker"	Johnsonburg	G	22.	7.	11.	Distillers' grains, cottonseed meal, oil meal, wheat middlings, corn meal, gluten, malt sprouts and salt.
			F	24.6	8.18	10.08	Distillers' grains, cottonseed meal, linseed meal, wheat middlings, corn meal, cornstarch by-product with corn bran, malt sprouts, salt.
5144	Jamestown Electric Mills, Jamestown, N. Y. "Purity Milk Maker	South Dayton	G	22.	7.	11.	Distillers' grains, cottonseed meal, oil meal, wheat middlings, corn meal, gluten, malt sprouts and salt.
			F	25.5	8.69	8.82	Distillers' grains, cottonseed meal, linseed meal, wheat middlings, corn meal, cornstarch by-product with corn bran, malt sprouts, salt.
5202	Jamestown Electric Mills, Jamestown, N. Y. "Purity Milk Maker"	Elmira	G	22.	7.	11.	Distillers' grains, cottonseed meal, oil meal, wheat middlings, corn meal, gluten, malt sprouts and salt.
			F	25.8	8.68	8.37	Distillers' grains, cottonseed meal, linseed meal, wheat middlings, corn meal, cornstarch by-product with corn bran, malt sprouts, salt.

* These letters indicate, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
			Per ct.	*Per ct.*	*Per ct.*	
	COMPOUNDED FEEDS (*continued*):					
4966	Chas. A. Krause Milling Co., Milwaukee, Wis. "Badger Fancy Mixed Feed"	Fort Plain	G* 11.	3.	9.	Made from wheat bran and maizo red dog flour.
			F* 13.6	5.34	5.69	Wheat bran, low grade corn flour.
4995	The Larrowe Milling Co., Detroit, Mich. "Larro-Feed"	Montgomery	G 19.	3.	14.	Choice cottonseed meal, gluten feed, dried distillers' grains, dried beet pulp, wheat bran, wheat middlings and three-fourths of 1 per cent salt.
			F 20.3	3.68	11.9	Cottonseed meal, cornstarch by-product with corn bran, dried distillers' grains, dried beet pulp, wheat bran, wheat middlings, salt.
5012	The Larrowe Milling Co., Detroit, Mich. "Larro-Feed"	Stamford	G 19.	3.	14.	
			F 19.9	4.31	13.39	Cottonseed meal, cornstarch by-product with corn bran, dried distillers' grains, dried beet pulp, wheat bran, wheat middlings, salt.
4811	Law & Wilber, Inc., Collins, N. Y. "Square Deal Dairy Ration"	Collins	G 25.	7.	11.	Corn distillers' grains, hominy and corn meal, owl 41 per cent cottonseed meal, fancy winter wheat bran, old process oil meal, fancy malt sprouts, gluten.
			F 23.9	6.5	8.33	As certified.
5053	Law & Wilber, Collins, N. Y. "Square Deal Dairy Ration"	Sandy Creek	G 25.	7.	11.	Corn distillers' grains, hominy and corn meal, owl 41 per cent cottonseed meal, fancy winter wheat bran, old process oil meal, fancy malt sprouts, gluten.
			F 24.4	6.48	8.39	As certified.

5187	Long Dock Mills and Elevator, Jersey City, N. J. "Ground Feed"	Nanuet	G	7.	3.	11.	Corn chops, oats and barley.
			F	9.	3.26	5.48	Corn, oats, barley.
4854	J. J. Martin, Perry, N. Y. "Corn, Oats and Bran"	Perry	G	12.75	4.89	4.72	Corn, oats and bran.
			F	11.3	4.03	5.46	Corn, oats, wheat bran.
4986	Matthews & Harrison, Kingston, N. Y. "Arcade Stock Feed"	Kingston	G	7.5	3.25	13.	Ground corn, ground oats, oat hulls, hominy, wheat middlings, gluten feed and salt.
			F	8.4	3.23	13.54	Ground corn, corn bran, ground oats, oat hulls, hominy feed, wheat middlings, cornstarch by-product with corn bran, salt.
5193	Matthews & Harrison, Kingston, N. Y. "Ulster Chop Feed"	Kingston	G	7.	3.5	10.	Ground corn, ground oats, oat hulls, middlings, hominy, cob meal, oat screenings, barley screenings and salt.
			F	8.6	3.01	12.48	As certified.
4951	Moses Bros., Eaton, N. Y. "Corn and Oats"	Delanson	G	——	——	——	Corn and oats, half and half.
			F	10.7	4.25	5.71	As certified.
5046	Edward D. Mourin, Homer, N. Y. "Bran, Meal and Middlings"	Homer	G	——	——	——	Bran, meal and middlings.
			F	12.25	5.09	4.91	Wheat bran, wheat middlings, corn meal, wheat screenings.
4894	Mystic Milling and Feed Co., Rochester, N. Y. "Mystic Feed for Horses, Cattle and Swine"	Rochester	G	8.	3.	11.	Oats, oat hulls, oat middlings, corn meal, corn bran, rye middlings, cottonseed meal.
			F	11.2	4.45	8.36	As certified.
4985	Mystic Milling & Feed Co., Rochester, N. Y. "Mystic Feed for Horses, Cattle and Swine"	Rondout	G	8.	3.	11.	Oats, oat hulls, oat middlings, corn meal, corn bran, rye middlings, cottonseed meal.
			F	10.5	3.68	10.97	As certified.

* These letters indicate, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
			Per ct.	*Per ct.*	*Per ct.*	
	COMPOUNDED FEEDS (*continued*):					
4632	Northern Illinois Cereal Co., Lockport, Ill. "Famous Feed"	Mexico	G* 8.	4.	——	
			F* 7.56	2.36	11.11	Corn meal, oat hulls.
4740	Northern Illinois Cereal Co., Lockport, Ill. "Peru C. & O. Feed"	Syracuse	G 8.	3.5	12.	Ground corn, oat middlings, oat hulls.
			F 8.9	3.43	9.61	As certified.
4846	North-West Mills Co., Winona, Minn. "Sugarota Calf Meal"	Jamestown	G 25.	6.	——	Made of pulverized wheat, pulverized malt, linseed meal and cottonseed meal.
			F 24.4	5.35	3.67	As certified.
5351	North-West Mills Co., Winona, Minn. "Sugarota Calf Meal"	Middleville	G 25.	6.	6.	Made of pulverized wheat, pulverized malt, linseed meal and cottonseed meal.
			F 24.6	5.16	3.07	As certified.
4645	North-West Mills Co., Winona, Minn. "Sugarota Milk Meal"	Fernwood	G 25.	6.	9.	Made from barley, malt sprouts, pure wheat bran, choice cottonseed meal, choice middlings, and a small percentage of salt.
			F 26.5	4.68	10.18	As certified.
4994	North-West Mills Co., Winona, Minn. "Sugarota Milk Meal"	Montgomery	G 25.	6.	9.	Barley malt sprouts, pure wheat bran, choice cottonseed meal, choice middlings and a small percentage of salt.
			F 26.1	4.42	10.72	As certified.

5006	North-West Mills Co., Winona, Minn. "Sugarota Milk Meal"	Oneonta	G	25.	6.	9.	Barley malt sprouts, pure wheat bran, choice cottonseed meal, choice middlings and a small percentage of salt.
			F	23.	5.11	9.78	As certified.
5116	North-West Mills Co., Winona, Minn. "Sugarota Milk Meal"	Olean	G	25.	6.	9.	Made of barley malt sprouts, pure wheat bran, choice cottonseed meal, choice middlings and a small per cent of salt.
			F	19.3	4.06	14.71	Malt sprouts, wheat bran, wheat middlings, cottonseed meal, screenings containing weed seeds, salt.
4826	A. Nowak & Son, Buffalo, N. Y. "Buffalo Horse Feed"	Akron	G	7.	3.	12.	Corn, hominy, oats, oat hulls and middlings.
			F	8.6	4.18	13.44	As certified.
4859	A. Nowak & Son, Buffalo, N. Y. "Buffalo Horse Feed"	Rock Glen	G	7.	3.	12.	Corn, hominy, oats, oat hulls and middlings.
			F	8.7	3.44	13.48	Corn meal, hominy feed, oats, oat hulls, oat middlings.
5406	A. Nowak & Son, Buffalo, N. Y. "Buffalo Horse Feed"	Ravena	G	7.	3.	12.	Corn, hominy, oats, oat hulls and middlings.
			F	7.3	2.59	10.79	Corn, hominy feed, oats, oat middlings, oat hulls.
5098	A. Nowak & Son, Buffalo, N. Y. "Justice Stock Feed"	Dolgeville	G	10.	3.	9.	Ground corn, ground oats, oil meal, wheat middlings, oat mill by-products oat middlings, oat hulls, oat shorts, and one-half of 1 per cent salt.
			F	10.	4.08	9.27	Ground corn, ground oats, wheat middlings, oat middlings, oat shorts, oat hulls.
5064	Ogdensburg Roller Mills, Ogdensburg, N. Y. "Oswegatchie Chop Feed"	Ogdensburg	G	7.83	3.29	12.	Corn meal, crushed oats, and corncob meal.
			F	7.7	2.73	13.01	As certified.

* These letters indicate, respectively, Guaranteed and Found.

Analyses of Samples of Feeding Stuffs (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.		Crude protein.	Crude fat.	Crude fiber.	Ingredients.
				Per ct.	Per ct.	Per ct.	
	Compounded Feeds (*continued*):						
5346	Olean Mills, Olean, N. Y. "Chop Feed"	Olean	G*	7.	2.	8.	Corn, hominy, barley, oats, oat hulls, and oat middlings.
			F*	8.4	3.17	4.06	As certified.
5235	Oneida Milling Corporation, Oneida, N. Y. "Dolly Dimple Milk Maker"	Oneida	G	26.	6.	10.	Oneida Chief corn meal, Oneida Chief wheat middlings, Oneida Chief wheat bran, corn distillers' grains, owl 41 per cent cottonseed meal, old process oil meal, fancy malt sprouts, gluten.
			F	24.4	7.56	6.08	Corn meal, wheat bran, wheat middlings, dried distillers' grains, cottonseed meal, linseed meal, cornstarch by-product with corn bran.
5184	Wm. Orr & Sons, Orr's Mills, N. Y. "Orr's Mixed Feed"	Orr's Mills	G	7.	2.	15.	Whole corn, corn feed meal, corn bran, oat hulls, whole oats, oat clippings, oat middlings, rye middlings, wheat middlings, salt.
			F	11.7	3.93	6.60	As certified.
5048	Oliver D. Perry, McGraw, N. Y. "Mixed Feed"	McGraw	G	——	——	——	Corn meal, wheat bran and hominy.
			F	11.7	4.5	8.63	As certified.
5205	Phelps & Sibley Co., Cuba, N. Y. "White P. & S. Feed"	Canisteo	G	7.	4.	8.	White corn, white hominy, oat hulls.
			F	8.4	4.16	5.73	Corn, hominy feed, oat hulls.
5190	Phelps & Sibley Co., Cuba, N. Y. "Yellow P. & S. Feed"	Spring Valley	G	7.	3.	9.	Western corn and oat hulls.
			F	10.7	5.7	6.27	Corn, oats, oat hulls.

[illegible]	Phelps & Sibley Co., Cuba, N. Y. "Yellow P. & S. Feed"	Ithaca	G	7.	3.	9.	Western corn and oat hulls.
			F	8.9	4.07	5.35	As certified.
4765	The Quaker Oats Co., Chicago, Ill. "Boss Feed"	Albany	G	8.	3.	12.	Made from corn, oat meal mill by-product (oat middlings, oat hulls, oat shorts), flax plant by-product and one-half of 1 per cent salt.
			F	8.7	5.38	10.86	As certified.
5049	The Quaker Oats Co., Chicago, Ill. "Boss Feed"	Fayetteville	G	8.	3.	9.	Corn, oat meal mill by-product (oat middlings, oat hulls, oat shorts), flax plant by-product, and one-half of 1 per cent salt.
			F	8.8	5.38	9.58	As certified.
5345	The Quaker Oats Co., Chicago, Ill. "C. O. and B. Feed"	Ellicottville	G	10.	3.25	10.	Ground corn, ground barley, wheat flour, wheat middlings, oat meal mill by-products (oat middlings, oat hulls, oat shorts), cottonseed meal and one-half of 1 per cent salt.
			F	11.4	4.25	11.22	As certified.
5109	The Quaker Oats Co Chicago, Ill. "Mas-All Feed"	Franklinville	G	9.5	1.4	2.	Made from corn by-products.
			F	9.1	1.55	.58	Corn by-products. Contains salt.
4658	The Quaker Oats Co., Chicago, Ill. "Schumacher Calf Meal"	Attica	G	19.	8.	3.	Oat meal, wheat meal, ground flaxseed and dried milk.
			F	19.13	7.03	2.28	As certified.
4716	The Quaker Oats Co., Chicago, Ill. "Schumacher Calf Meal"	Sanitaria Springs	G	19.	8.	3.	Oat meal, wheat meal, ground flaxseed and dried milk.
			F	19.9	6.49	2.44	As certified.
4758	The Quaker Oats Co., Chicago, Ill. "Schumacher Calf Meal"	Albany	G	19.	8.	3.	Made from oat meal, wheat meal, ground flaxseed and dried milk.
			F	19.	7.38	2.07	As certified.

* These letters indicate, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
			Per ct.	*Per ct.*	*Per ct.*	
	COMPOUNDED FEEDS (*continued*):					
4676	The Quaker Oats Co., Chicago, Ill. "Schumacher Stock Feed"	Elba	G* 10.	3.25	10.	Ground corn, ground barley, wheat middlings, oat meal mill by-products (oat middlings, oat hulls, oat shorts), cottonseed meal and one-half of 1 per cent salt.
			F* 11.1	4.33	9.69	As certified.
4720	The Quaker Oats Co., Chicago, Ill. "Schumacher Stock Feed, A Kiln Dried Ration"	Binghamton	G 10.	3.25	10.	Ground corn, ground barley, wheat flour, wheat middlings, oat meal mill by-product (oat middlings, oat hulls, oat shorts), cottonseed meal and one-half of 1 per cent salt.
			F 11.	4.09	9.28	As certified.
4778	The Quaker Oats Co., Chicago, Ill. "Schumacher Stock Feed"	Troy	G 10.	3.25	10.	Ground corn, ground barley, wheat flour, wheat middlings, oat meal mill by-product (oat middlings, oat hulls, oat shorts), cottonseed meal and one-half of 1 per cent salt.
			F 11.1	4.33	6.23	As certified.
4825	The Quaker Oats Co., Chicago, Ill. "Schumacher Stock Feed"	Akron	G 10.	3.25	10.	Ground corn, ground barley, wheat flour, wheat middlings, oat meal mill by-products (oat middlings, oat hulls, oat shorts), cottonseed meal and one-half of 1 per cent salt.
			F 10.8	4.01	9.68	As certified.

5325	The Quaker Oats Co., Chicago, Ill. "Schumacher Special Horse Feed"	Buffalo	G	9.25	3.25	8.	Ground corn, crushed oats, oat meal mill by-products (oat middlings, oat hulls, oat shorts), one-half of 1 per cent salt.
			F	10.3	3.99	6.02	As certified.
5043	The Quaker Oats Co., Chicago, Ill. "Sterling Stock Feed"	Whitney Point	G	10.	3.25	10.	Ground corn, ground barley, wheat flour, wheat middlings, cottonseed meal, oat meal mill by-product (oat middlings, oat hulls, oat shorts), and one-half of 1 per cent salt.
			F	14.6	4.36	10.56	As certified.
5070	The Quaker Oats Co., Chicago, Ill. "Sterling Stock Feed"	Malone Junction	G	10.	3.25	9.	Made from corn, barley, wheat flour, cottonseed meal, oat meal mill by-products (oat middlings, oat hulls, oat shorts), and one-half of 1 per cent salt.
			F	10.2	3.78	9.89	As certified.
5155	The Quaker Oats Co., Chicago, Ill. "Sterling Stock Feed"	Middletown	G	10.	3.25	10.	Ground corn, ground barley, wheat flour, wheat middlings, cottonseed meal, oat meal mill by-product (oat middlings, oat hulls, oat shorts), and one-half of 1 per cent salt.
			F	11.2	4.32	9.5	As certified.
5343	The Quaker Oats Co., Chicago, Ill. "Sterling Stock Feed"	Clymer	G	10.	3.25	9.	Corn, barley, wheat flour, cottonseed meal, oat meal mill by-products (oat middlings, oat hulls, oat shorts), and one-half of 1 per cent salt, wheat middlings.
			F	11.6	4.59	10.25	As certified.
4697	The Quaker Oats Co., Chicago, Ill. "Victor Feed"	Arcade	G	8.	3.	12.	Ground corn, oat meal mill by-products (oat middlings, oat hulls, oat shorts), flax plant by-product and one-half of 1 per cent salt.
			F	9.1	5.47	9.37	As certified.

* These letters indicate, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.		Crude protein.	Crude fat.	Crude fiber.	Ingredients.
				Per ct.	*Per ct.*	*Per ct.*	
	COMPOUNDED FEEDS (*continued*):						
4764	The Quaker Oats Co., Chicago, Ill. "Victor Feed"	Albany	G*	8.	3.	12.	Ground corn, oat meal mill by-products (oat middlings, oat hulls, oat shorts), flax plant by-product, one-half of 1 per cent salt.
			F*	8.9	5.21	9.91	As certified.
5142	The Quaker Oats Co., Chicago, Ill. "Victor Feed"	Albion	G	8.	3.	12.	Ground corn, oat meal mill by-products (oat middlings, oat hulls, oat shorts), flax plant by-product, one-half of 1 per cent salt.
			F	9.1	5.43	10.61	As certified.
4616	The Quaker Oats Co., Chicago, Ill. "White Diamond Feed"	Massena	G	8.	3.25	9.	Ground corn, oat meal mill by-products (oat middlings, oat hulls, oat shorts) and one-half of 1 per cent salt.
			F	9.	4.19	7.53	As certified.
5161	The Quaker Oats Co., Chicago, Ill. "White Diamond Feed"	Westtown	G	8.	3.25	9.	Ground corn, oat meal mill by-product (oat middlings, oat hulls, oat shorts), and one-half of 1 per cent salt.
			F	8.6	3.04	6.53	As certified.
3888	Ralston Purina Co., St. Louis, Mo. "Purina Feed"	New York	G	12.	4.	9.8	Cracked corn, whole oats, brewers' dried grains, hominy feed and ground alfalfa.
			F	14.4	4.18	11.57	Cracked corn, oats, dried brewers' grains, hominy feed, alfalfa meal, salt.

4839	The Randolph Mills, Randolph, N. Y. "Red Mill Perfection Dairy Feed"	Randolph	G	25.	7.	11.	Corn distillers' grains, hominy feed and corn meal, 41 per cent cottonseed meal, fancy winter wheat bran, old process oil meal, fancy malt sprouts, gluten feed.
			F	25.3	6.69	9.	Dried distillers' grains, hominy feed, corn meal, wheat bran, cottonseed meal, linseed meal, malt sprouts, cornstarch by-product with corn bran.
4782	Andrew Ruff's Sons, Troy, N. Y. "Ground Feed"	Troy	G	13.25	4.5	6.	Ground oats, corn meal, bran, one-third each by weight.
			F	11.9	4.49	6.78	As certified.
3882	John Ryan, Port Chester, N. Y. "Sawpit Dairy Feed"	Port Chester	G	10.	6.	15.	Alfalfa meal, corn meal, cottonseed meal, corn bran, ground wheat screenings, ground oats and oat hulls, one-half of 1 per cent salt.
			F	9.7	3.69	13.89	Alfalfa meal, corn meal, corn bran, ground oats, oat hulls, wheat screenings containing weed seeds, salt.
5200	Saratoga Milling & Grain Co., Saratoga, N. Y. "Feed"	Saratoga	G	——	——	——	Corn and oats.
			F	10.2	4.39	4.86	Ground corn and oats.
3858	Shaw & Truesdell Co., Brooklyn, N. Y. "Ground Feed"	Brooklyn	G	9.43	3.07	10.04	Oat hulls, corn meal.
			F	9.2	3.23	3.46	Corn meal, light oats, oat hulls, screenings containing weed seeds partly ground.
5340	David Stott, Detroit, Mich. "Winner Chop Feed"	Lockport	G	9.	5.	10.	Corn meal and oats, ground wheat screenings, oat hulls and salt.
			F	9.3	5.78	8.53	As certified.
4713	Tioga Mill & Elevator Co., Waverly, N. Y. "Derby Stock Feed"	Sanitaria Springs	G	10.5	4.9	9.	Corn offal, hominy, gluten, oat middlings, oat hulls.
			F	11.	5.4	10.78	Corn offal, hominy feed, cornstarch by-product with corn bran, oat middlings, oat hulls.

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ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
			Per ct.	*Per ct.*	*Per ct.*	
	COMPOUNDED FEEDS (*continued*):					
4781	Tioga Mill & Elevator Co., Waverly, N. Y. "Derby Stock Feed"	Watervliet	G* 10.5	4.9	9.	Corn offal, hominy, gluten, oat middlings, oat hulls.
			F* 11.5	5.44	11.71	Corn offal, hominy feed, cornstarch by-product with corn bran, oat middlings, oat hulls.
5059	Tioga Mill & Elevator Co., Waverly, N. Y. "Derby Stock Feed"	Clinton	G 10.5	4.9	9.	Corn offal, hominy, gluten, oat middlings, oat hulls.
			F 12.	7.1	9.09	Corn offal, hominy feed, cornstarch by-product with corn bran, oat middlings, oat hulls.
4780	Tioga Mill & Elevator Co., Waverly, N. Y. "Economy Feed"	Watervliet	G 10.	5.	17.25	Hominy, brewers' grains, corn offal, cob meal, oat hulls and oat middlings.
			F 9.9	5.3	15.37	As certified.
5251	Tioga Mill & Elevator Co., Waverly, N. Y. "Economy Feed"	Waverly	G 10.	5.	17.25	Hominy, brewers' grains, corn offal, cob meal, oat hulls and oat middlings.
			F 10.5	4.45	14.33	As certified.
5104	The Toledo Elevator Co., Toledo, O. "Star Feed"	Chaffee	G 7.	5.5	12.5	Hominy feed, ground corncob, containing one-half of 1 per cent salt.
			F 9.8	5.83	8.2	As certified.
5211	The Toledo Elevator Co., Indianapolis, Ind. "Star Feed"	Waverly	G 7.	5.5	12.5	Hominy feed and ground corncob, containing one-half of one per cent salt.
			F 9.	5.76	9.4	Hominy feed, ground corncob.
5252	The Toledo Elevator Co., Indianapolis, Ind. "Star Feed"	Waverly	G 8.	6.	9.	Hominy feed, corn and ground corncob, containing one-half of 1 per cent salt.
			F 9.	5.74	7.22	As certified.

4852	Geo. Tomlinson & Son Perry, N. Y. " Chop Feed "	Perry	G F	11.31 11.	4.51 4.59	4.59 5.71	Corn, oats and bran. Corn, oats, wheat bran.
5015	Van Buren & Conkling, Hobart, N. Y. " Horse Feed No. 2 "	Hobart	G F	11. 11.9	4. 4.12	5. 5.21	Corn, oats, barley and wheat feed. Corn, oats, barley, wheat bran, wheat middlings.
519[illegible]	A. Waller & Co., Henderson, Ky. " Blue Grass Feed "	Granville	G F	9. 8.9	2. 2.6	17. 17.31	Winter wheat bran, winter wheat middlings, ground corn and cob. Wheat bran, wheat middlings, corn meal, ground corncob.
5204	A. Waller & Co., Henderson, Ky. " Blue Grass Feed "	Canisteo	G F	9. 8.9	2. 2.65	17. 16.6	Winter wheat bran, winter wheat middlings, ground corn and cob. Wheat bran, wheat middlings, corn meal, ground corncob.
4971	A. Waller & Co., Henderson, Ky. " Oneida Mixed Feed "	Canajoharie	G F	10. 10.3	2.5 2.89	17. 14.35	Winter wheat bran, winter wheat middlings, ground corn and cob. Wheat bran, wheat middlings, corn meal, ground corncob.
5061	A. Waller & Co., Henderson, Ky. " Oneida Mixed Feed "	Rome	G F	10. 10.	2.5 2.75	17. 15.86	Winter wheat bran, winter wheat middlings, ground corn and cob. Wheat bran, wheat middlings, corn meal, ground corncob.
5236	A. Waller & Co., Henderson, Ky. " Oneida Mixed Feed "	Canastota	G F	10. 10.5	2.5 3.07	15. 13.43	Winter wheat bran, winter wheat middlings, ground corn and cob. Wheat bran, wheat middlings, corn meal, ground corncob.
5176	The Otto Weiss Alfalfa Stock Food Co., Wichita, Kan. " Otto Weiss Stock Feed "	Newburgh	G F	11. 12.7	3.5 3.76	14. 11.36	Alfalfa, corn chop, wheat bran, shorts and oats, three-fourths of 1 per cent salt. Alfalfa, cracked corn, oats, wheat bran, salt.

* These letters indicate, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
			Per ct.	*Per ct.*	*Per ct.*	
	COMPOUNDED FEEDS (*continued*):					
5322	The Otto Weiss Alfalfa Stock Food Co., Wichita, Kan. "Otto Weiss Stock Food"	Buffalo	G* 11.	3.5	14.	Alfalfa, corn chop, bran, shorts and three-fourths of 1 per cent salt.
			F* 13.1	3.41	10.44	Alfalfa meal, cracked corn, wheat bran, wheat middlings, salt.
5182	Frank C. Wessells, Mountainville, N. Y. "Feed"	Mountainville	G 6.	2.	6.	Made of oats and corn ground with wheat middlings with about 1 per cent salt.
			F 12.9	4.1	4.84	As certified.
4920	W. J. Wheelock Co., Greigsville, N. Y. "Banner Horse Feed"	Batavia	G 12.	4.	9.	Oats, corn, oil meal, gluten, middlings, oat hulls, three-fourths of 1 per cent salt.
			F 12.	4.56	5.64	Corn, oats, linseed meal, cornstarch by-product with corn bran, wheat middlings, oat hulls.
	MOLASSES FEEDS (COMPOUNDED):					
4644	American Milling Co., Chicago, Ill. "Sucrene Dairy Feed"	Fernwood	G 16.5	3.5	12.	Cottonseed meal, gluten feed, molasses, oat clippings and ground and bolted grain screenings, one-half of 1 per cent salt.
			F 17.54	5.12	10.44	As certified.
4709	American Milling Co., Chicago, Ill. "Sucrene Dairy Feed"	Union	G 16.5	3.5	12.	Cottonseed meal, gluten feed, molasses, oat clippings and ground and bolted grain screenings, one-half of 1 per cent salt.
			F 17.	5.23	10.06	Cottonseed meal, corn meal, oat clippings, ground grain screenings, molasses.

4754	American Milling Co., Chicago, Ill. "Sucrene Dairy Feed"	Albany	G	16.5	3.5	9.	Cottonseed meal, gluten feed, molasses, oat clippings and ground and bolted grain screenings, one-half of 1 per cent salt.
			F	17.8	5.19	11.26	Cottonseed meal, cornstarch by-product with corn bran, oat clippings, ground grain screenings, salt, molasses.
4755	American Milling Co., Chicago, Ill. "Sucrene Dairy Feed"	Albany	G	16.5	3.5	12.	Cottonseed meal, gluten feed, molasses, oat clippings and ground and bolted grain screenings, one-half of 1 per cent salt.
			F	17.2	4.76	11.69	Cottonseed meal, cornstarch by-product with corn bran, oat clippings, ground grain screenings, salt, molasses.
5084	American Milling Co., Chicago, Ill. "Sucrene Horse and Mule Feed"	Gouverneur	G	10.	2.5	12.	Corn, cottonseed meal, molasses and ground and bolted grain screenings, one-half of 1 per cent salt.
			F	14.8	3.75	10.83	Corn, cottonseed meal, ground grain screenings, molasses.
5013	American Milling Co., Chicago, Ill. "Sucrene Mixing Feed"	Stamford	G	12.	2.50	12.	Gluten feed, molasses, oat clippings and ground and bolted grain screenings, one-half of 1 per cent salt.
			F	14.3	7.58	11.38	Cornstarch by-product without corn bran, oat clippings and ground grain screenings, molasses.
5146	American Milling Co., Chicago, Ill. "Sucrene Mixing Feed"	Little Valley	G	12.	2.5	12.	Gluten feed, molasses, oat clippings and ground and bolted grain screenings, one-half of 1 per cent salt.
			F	14.	5.36	11.27	Cornstarch by-product with corn bran, cottonseed meal, oat clippings and grain screenings containing a small amount of weed seeds, molasses.

* These letters indicate, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
	MOLASSES FEEDS (COMPOUNDED) (*continued*):		*Per ct.*	*Per ct.*	*Per ct.*	
4900	The Attica Mills, Chesbro Bros., Attica, N. Y. "Screening Feed with Molasses"	Attica	G* ——	——	——	Wheat screenings and molasses.
			F* 13.7	6.69	8.14	Grain screenings containing weed seeds partly ground, molasses.
4921	Clover Leaf Milling Co., Buffalo, N. Y. "Peerless Dairy Ration"	Seneca Falls	G 21.	7.	9.	Gluten feed, distillers' grains, wheat bran, cottonseed meal, molasses and a small percentage of salt.
			F 18.3	4.67	9.99	Cornstarch by-product with corn bran, distiller's grains, wheat bran, cottonseed meal, salt, screenings, molasses.
5459	Clover Leaf Milling Co., Buffalo, N. Y. "Peerless Dairy Ration"	Kennedy	G 21.	7.	9.	Gluten feed, distillers' grains, wheat bran, cottonseed meal, molasses and a small percentage of salt.
			F 20.8	4.02	11.32	Cornstarch by-product with corn bran, dried distillers' grains, wheat bran, cottonseed meal, screenings, molasses.
3851	Erler & Co., Riverhead, N. Y. "Erler's Old German Molasses Feed"	Riverhead	G 10.08	3.	3.63	Best grade corn meal, wheat bran, oil meal, molasses and 1 per cent salt.
			F 9.5	2.52	4.5	Corn meal, wheat bran, linseed meal, molasses, salt.
5145	Faramel Mfg. Co., Buffalo, N. Y. "Bogg's Competition Horse Feed"	Dayton	G 10.	3.	6.	Rolled oats, cracked corn, corn meal, wheat bran and molasses.
			F 9.5	3.52	5.5	Corn, oats, wheat bran, molasses.
4841	Faramel Mfg. Co., Buffalo, N. Y. "Faramel Dairy Feed"	Jamestown	G 15.	3.	10.	Gluten, malt sprouts, wheat bran, corn meal and molasses.
			F 10.3	2.16	4.15	Cornstarch by-product with corn bran, malt sprouts, wheat bran, corn meal, molasses.

4858	Faramel Mfg. Co., Buffalo, N. Y. "Faramel Horse Feed"	Warsaw	G	9.	4.	6.	Oats, corn, wheat bran and molasses.
			F	8.9	3.45	5.39	As certified.
5314	Faramel Mfg. Co., Buffalo, N. Y. "Horse Feed"	Buffalo	G	9.	4.	6.	Oats, corn, wheat bran and molasses.
			F	9.8	3.51	5.35	As certified.
5245	F. W. Goeke & Co., St. Louis, Mo. "Atlas Dairy Feed"	Greene	G	20.	4.	12.	Ground wheat, ground corn, ground oats, ground barley, malt sprouts, brewers' dried grains, alfalfa meal, cottonseed meal, salt, molasses and ground grain screenings from wheat, corn, oats, barley and flax.
			F	20.3	4.58	12.04	Dried brewers' grains, alfalfa meal, cottonseed meal (ground screenings containing small amounts of corn, low grade wheat, light and immature oats, and barley), salt, molasses.
4799	F. W. Goeke & Co., St. Louis, Mo. "Holstein Sugar Feed"	Cherry Valley	G	16.	3.	12.	Ground wheat, ground corn, ground oats, ground barley, malt sprouts, alfalfa meal, cottonseed meal, salt, molasses and ground grain screenings from wheat, corn, oats, flax and barley.
			F	19.7	3.63	10.79	Cottonseed meal, alfalfa meal, barley, light oats, (screenings from wheat, corn, oats, flax and barley, containing weed seeds partly ground), ground cocoa shells, salt, molasses.
5034	F. W. Goeke & Co., St. Louis, Mo. "Holstein Sugar Feed"	Sydney	G	16.	3.	12.	Wheat, corn, oats, barley, malt sprouts, alfalfa meal, cottonseed meal, salt, screenings and molasses.
			F	14.1	3.16	10.9	Cottonseed meal, alfalfa meal, barley, light oats, (screenings from wheat, corn, oats, flax and barley containing weed seeds partly ground), ground cocoa shells, salt, molasses.

* These letters indicate, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
			Per ct.	*Per ct.*	*Per ct.*	
	MOLASSES FEEDS (COMPOUNDED) (*continued*):					
3861	Globe Molasses Feed Co., Brooklyn, N. Y. "Globe Molasses Feed"	Brooklyn	G* 4.05	.25	13.25	Ground oats, whole grain screenings, cracked corn, whole rye, cane molasses.
			F* 6.8	1.37	10.37	Oats, light oats, screenings, molasses.
4650	Husted Milling Co., Buffalo, N. Y. "Husted Alfalfa Horse Feed"	Watertown	G 10.	3.	15.	Alfalfa meal, cracked corn, barley, oil meal, whole oats, wheat bran, molasses, salt three-fourths of 1 per cent.
			F 10.47	3.35	10.7	Alfalfa meal, cracked corn, barley, corn bran, linseed meal, oats, wheat bran, salt, molasses.
4679	Husted Milling Co., Buffalo, N. Y. "Husted Alfalfa Horse Feed"	Byron	G 10.	3.	15.	Alfalfa meal, cracked corn, barley, oil meal, whole oats, wheat bran, molasses, salt three-fourths of 1 per cent.
			F 11.5	4.62	6.3	Alfalfa meal, cracked corn, barley, corn bran, linseed meal, oats, salt, molasses.
4646	Husted Milling Co., Buffalo, N. Y. "Husted Molasses Feed"	Redwood	G 18.	4.	9.	Cottonseed meal, gluten feed, oat clips, corn meal, oil meal, wheat middlings, distillers' grains, malt sprouts, salt three-fourths of 1 per cent, molasses.
			F 19.3	4.54	7.63	Cornstarch by-product with corn bran, cottonseed meal, oat clippings and grain screenings, corn meal, linseed meal, wheat middlings, distillers' grains, malt sprouts, salt, molasses.

4670	Husted Milling Co., Buffalo, N. Y. "Husted Molasses Feed"	Darien Center	G	18.	4.	9.	Cottonseed meal, gluten feed, oat clips, corn meal, oil meal, wheat middlings, distillers' grains, malt sprouts, molasses, salt three-fourths of 1 per cent.
			F	24.4	4.76	7.35	Cottonseed meal, cornstarch by-product with corn bran, oat clippings and grain screenings, corn meal, linseed meal, wheat middlings, distillers' grains, malt sprouts, molasses, salt.
4798	Husted Milling Co., Buffalo, N. Y. "Husted Molasses Feed"	Cherry Valley	G	18.	4.	9.	Cottonseed meal, gluten feed, oat clips, corn meal, oil meal, wheat middlings, distillers' grains, malt sprouts, molasses, salt three-fourths of 1 per cent.
			F	22.8	4.49	7.29	Cottonseed meal, corn starch by-product with corn bran, oat clippings and grain screenings, corn meal, linseed meal, wheat middlings, distillers' grains, dried brewers' grains, salt, molasses.
4959	Husted Milling Co., Buffalo, N. Y. "Husted Molasses Feed"	Guilderland Center	G	18.	4.	9.	Cottonseed meal, gluten feed, oat clips, corn meal, oil meal, wheat middlings, distillers' grains, malt sprouts, molasses, salt three-fourths of 1 per cent.
			F	20.9	4.75	7.06	Cottonseed meal, cornstarch by-product with corn bran, oat clippings and grain screenings, corn meal, linseed meal, wheat middlings, dried distillers' grains, dried brewers' grains, malt sprouts, salt, molasses.

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ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
	MOLASSES FEEDS (COMPOUNDED) (*continued*):		*Per ct.*	*Per ct.*	*Per ct.*	
5017	Husted Milling Co., Buffalo, N. Y. "Husted Molasses Feed"	Oneonta	G* 18.	4.	9.	Cottonseed meal, gluten feed, oat clips, corn meal, oil meal, wheat middlings, distillers' grains, malt sprouts, molasses, salt three-fourths of 1 per cent.
			F* 19.2	4.81	7.11	Cottonseed meal, cornstarch by-product with corn bran, oat clippings and grain screenings, corn meal, linseed meal, wheat middlings, dried distillers' grains, dried brewers' grains, malt sprouts, salt, molasses.
3849	Husted Milling Co., Buffalo, N. Y. "Husted Oatmolene Horse Feed"	Batavia	G 9.	3.	7.	Ground oats, cracked corn, corn bran, wheat bran, molasses.
			F 12.16	5.	7.18	As certified.
4745	Husted Milling Co., Buffalo, N. Y. "Husted Oatmolene Horse Feed"	Syracuse	G 9.	3.	7.	Ground oats, cracked corn, corn meal, wheat bran, molasses.
			F 10.9	3.95	5.55	As certified.
5106	Husted Milling Co., Buffalo, N. Y. "Husted Oatmolene Horse Feed"	Chaffee	G 9.	3.	7.	Ground oats, cracked corn, corn meal, wheat bran, molasses.
			F 11.1	4.33	7.16	As certified.
5337	Husted Milling Co., Buffalo, N. Y. "Husted Germaline"	Buffalo	G 9.	3.	4.	Corn meal, molasses.
			F 8.9	3.26	1.63	As certified.
5339	Husted Milling Co., Buffalo, N. Y. "Molasses Corn Flakes"	Buffalo	G 7.	5.	9.	Corn bran, molasses.
			F 10.3	6.41	6.59	As certified.

5413	Husted Milling Co., Buffalo, N. Y. "Molasses Horse Feed"	Saugerties	G	7.	3.	9.	Corn, oats, oat clippings, middlings, molasses, salt three-fourths of 1 per cent.
			F	8.8	3.29	3.81	Corn feed meal, oats, light oats, oat clippings, wheat middlings, salt, molasses.
5451	Husted Milling Co., Buffalo, N. Y. "Molasses Horse Feed"	Buffalo	G	7.	3.	9.	Corn, oats, oat clippings, middlings, molasses, salt three-fourths of 1 per cent.
			F	8.5	3.77	3.69	Corn feed meal, oats, light oats, oat clippings, wheat middlings, salt, molasses.
3873	Illinois Feed Mills, St. Louis, Mo. "Star Molasses Feed"	New York	G	10.	2.3	12.	Cracked corn, whole oats, ground alfalfa and molasses.
			F	9.1	2.51	10.9	As certified.
5415	Illinois Feed Mills St. Louis, Mo. "Star Molasses Feed"	Poughkeepsie	G	10.	2.3	12.	Cracked corn, whole oats, ground alfalfa and molasses.
			F	9.5	2.57	9.14	As certified.
4625	International Sugar Feed Co., Minneapolis, Minn. "International Special Molasses Feed"	Antwerp	G	12.5	3.5	12.	Cottonseed meal, molasses, cleaned grain screenings (ground), oat clips containing oat hulls (ground), salt.
			F	14.47	4.96	12.43	Cottonseed meal, grain screenings containing weed seeds partly ground, oat clippings containing oat hulls (ground), salt, molasses.
4989	International Sugar Feed Co., Minneapolis, Minn. "International Special Molasses Feed"	Kingston	G	12.5	3.5	12.	Cottonseed meal, molasses, cleaned grain screenings (ground), oat clips (ground), salt.
			F	14.2	5.48	12.54	Cottonseed meal, grain screenings containing weed seeds partly ground, oat clippings, salt, molasses.

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ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
	MOLASSES FEEDS (COMPOUNDED) (*continued*):		*Per ct.*	*Per ct.*	*Per ct.*	
5004	International Sugar Feed Co., Minneapolis, Minn. "International Special Molasses Feed"	Oneonta	G 12.5	3.5	12.	Cottonseed meal, molasses, cleaned grain screenings, ground oat clips, salt.
			F 15.1	4.6	13.27	Cottonseed meal, grain screenings containing weed seeds partly ground, oat clippings, salt, molasses.
4990	International Sugar Feed Co., Minneapolis, Minn. "International Horse Feed"	Kingston	G 12.5	3.5	12.	Oats, barley, corn (grains are ground), alfalfa, oil meal, cottonseed meal, cleaned grain screenings (ground), oat clips (ground), molasses and salt.
			F 15.7	3.29	11.82	Ground corn, oats and barley, alfalfa, linseed meal, cottonseed meal, oat clippings, grain screenings containing weed seeds partly ground, salt, molasses.
5179	Kornfalfa Feed Milling Co., Kansas City, Mo. "Kay Molasses Feed"	Fishkill Landing	G 8. F 10.4	1.5 2.13	17. 14.64	Alfalfa, corn, oats, molasses. As certified.
3886	Kornfalfa Feed Milling Co., Kansas City, Mo. "Kornfalfa Kandy Feed"	New York	G 9. F 8.5	2.5 2.43	12. 9.39	Alfalfa, corn, oats, molasses. As certified.
5181	Kornfalfa Feed Milling Co., Kansas City, Mo. "Kornfalfa Kandy Feed"	Fishkill Landing	G 9. F 9.9	2.5 2.59	12. 9.01	Alfalfa, corn, oats, molasses. As certified.
4997	Chas. A. Krause Milling Co., Milwaukee, Wis. "Badger Alfalfa Horse and Mule Feed"	Goshen	G 10. F 9.8	2. 2.	12. 8.46	Corn, oats, alfalfa and syrup. As certified.

5320	Chas. A. Krause Milling Co., Milwaukee, Wis. "Badger Alfalfa Horse and Mule Feed"	Buffalo	G	10.	2.	12.	Made from corn, oats, alfalfa and syrup.
			F	10.7	2.36	9.95	Corn, oats, alfalfa, molasses.
4640	Chas. A. Krause Milling Co., Milwaukee, Wis. "Badger Dairy Feed"	Phoenix	G	16.	2.	15.	Composed of cottonseed meal, oil meal, malt sprouts, dried brewers' grains, alfalfa meal and molasses and one-fourth per cent salt.
			F	17.3	3.22	12.09	Cottonseed meal, linseed meal, malt sprouts, dried brewers' grains, alfalfa meal, screenings containing weed seeds mostly ground, salt, molasses.
4965	Chas. A. Krause Milling Co., Milwaukee, Wis. "Badger Dairy Feed"	Fort Plain	G	16.	2.	15.	Cottonseed meal, corn oil meal, malt sprouts, dried brewers' grains, alfalfa meal and molasses, one-half of 1 per cent salt.
			F	17.6	3.04	12.	Cottonseed meal, oil meal, malt sprouts, dried brewers' grains, alfalfa meal, screenings containing weed seeds partly ground, salt, molasses.
5219	Chas. A. Krause Milling Co., Milwaukee, Wis. "Badger Dairy Feed"	Candor	G	16.	2.	15.	Cottonseed meal, corn oil meal, malt sprouts, dried brewers' grains, alfalfa meal and molasses, one-fourth of 1 per cent salt.
			F	16.8	2.27	13.92	Cottonseed meal, oil meal, malt sprouts, dried brewers' grains, alfalfa meal, screenings containing weed seeds partly ground, salt, molasses.
3880	The Meader-Atlas Co., New York, N. Y. "Atlas Horse Feed"	Port Richmond	G	5.	1.	12.	Ground oats, corn and screenings, molasses, oat hulls, dried brewers' grains.
			F	6.4	1.04	7.8	Oats, corn, barley, oat hulls, screenings, molasses.

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ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
	MOLASSES FEEDS (COMPOUNDED) (*continued*):		*Per ct.*	*Per ct.*	*Per ct.*	
3881	The Meader-Atlas Co., New York, N. Y. "Blue Bell Cow Feed"	Port Richmond	G* 10.	2.	12.	Ground corn, dried brewers' grains, molasses, cottonseed meal, oat hulls, ground hay.
			F* 11.7	2.8	10.18	Dried brewers' grains, cottonseed meal, oat hulls, ground hay, ground screenings, molasses.
4629	North-West Mills Co., Winona, Minn. "Sugarota Dairy Feed"	Mexico	G 16.5	3.5	14.	Made of cottonseed meal, malt sprouts, mixed broken grains containing corn, wheat, oats, barley, spelt, etc., molasses and salt.
			F 18.1	4.64	12.01	Cottonseed meal, screenings containing weed seeds partly ground, salt, molasses.
4887	North-West Mills Co., Winona, Minn. "Sugarota Dairy Feed"	Palmyra	G 16.5	3.5	14.	Cottonseed meal, malt sprouts, mixed broken grains containing corn, wheat, barley, spelt, etc., molasses and salt.
			F 17.9	5.08	13.32	Cottonseed meal, malt sprouts, grain screenings containing weed seeds partly ground, molasses.
4993	North-West Mills Co., Winona, Minn. "Sugarota Dairy Feed"	Montgomery	G 16.5	3.5	14.	Cottonseed meal, malt sprouts, mixed broken grains containing corn, wheat, barley, spelt, etc., molasses and salt.
			F 16.8	4.94	13.95	Cottonseed meal, grain screenings containing weed seeds partly ground, molasses.

5036	North-West Mills Co., Winona, Minn. "Sugarota Dairy Feed"	Norwich	G	16.5	3.5	14.	Cottonseed meal, malt sprouts, mixed broken grains containing corn, wheat, oats, barley, spelt, etc., molasses and salt.
			F	17.1	4.27	12.96	Cottonseed meal, grain screenings containing weed seeds partly ground, salt, molasses.
5309	A. Nowak & Son, Buffalo, N. Y. "Molasses Horse Feed"	Buffalo	G	8.	2.	9.	Crushed oats, cracked corn, corn meal, wheat bran, molasses.
			F	10.2	4.52	5.46	As certified.
5311	Omaha Alfalfa Milling Co., Omaha, Neb. "Green Meadow Dairy Feed"	Cuba	G	11.	2.	25.	Alfalfa meal and syrup.
			F	14.4	.87	15.25	Alfalfa meal and molasses.
5149	Omaha Alfalfa Milling Co., Omaha, Neb. "Peerless Alfalmo Horse Feed"	Cuba	G	10.	2.	12.	Corn, oats, alfalfa meal, molasses.
			F	12.	2.61	8.12	As certified.
5189	Omaha Alfalfa Milling Co., Omaha, Neb. "Perfection Horse Feed"	Spring Valley	G	10.5	2.	12.	Corn, oats, alfalfa meal, molasses.
			F	10.75	2.64	9.72	As certified.
5312	Omaha Alfalfa Milling Co., Omaha, Neb. "Perfection Horse Feed"	Cuba	G	10.5	2.	12.	Corn, oats, alfalfa meal, molasses.
			F	11.8	2.54	6.71	As certified.
5305	M. C. Peters Mill Co., Omaha, Neb. "Alfalfa Queen Dairy Feed"	Dunkirk	G	17.5	3.	12.	Gluten meal, corn meal, cottonseed meal, alfalfa meal and molasses.
			F	18.9	4.35	7.05	Cornstarch by-product with corn bran, corn meal, cottonseed meal, alfalfa meal, molasses.
4843	M. C. Peters Mill Co., Omaha, Neb. "June Pasture Dairy Meal"	Jamestown	G	10.	.5	26.	Pure ground alfalfa and fine molasses.
			F	10.4	1.1	13.62	As certified.

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ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
	MOLASSES FEEDS (COMPOUNDED) (*continued*):		Per ct.	Per ct.	Per ct.	
5332	M. C. Peters Mill Co., Omaha, Neb. " June Pasture "	Buffalo	G* 10.	.5	26.	Pure alfalfa meal light with molasses.
			F* 11.2	1.05	15.73	Alfalfa and molasses.
4842	M. C. Peters Mill Co., Omaha, Neb. " Peters' Arab Horse Feed "	Jamestown	G 9.	2.	15.	Corn, oats, alfalfa and molasses.
			F 9.51	2.66	8.65	As certified.
4982	M. C. Peters' Mill Co., Omaha, Neb. " Peters' Arab Horse Feed "	Albany	G 9.	2.	15.	Corn, oats, alfalfa and molasses.
			F 10.2	2.72	9.13	As certified.
5323	M. C. Peters Mill Co., Omaha, Neb. " Peters' King Corn Sugar Feed "	Buffalo	G 9.	1.5	18.	A balance ration — corn, oats, alfalfa and molasses.
			F 10.3	2.72	12.7	As certified.
4613	The Quaker Oats Co., Chicago, Ill. " Blue Ribbon Dairy Feed "	Potsdam	G 25.	4.	9.	Made from wheat bran, cottonseed meal, malt sprouts, molasses, hominy feed and oat clippings.
			F 24.72	4.63	11.66	Wheat bran, cottonseed meal, malt sprouts, hominy feed, oat clippings and oat hulls, molasses.
4681	The Quaker Oats Co., Chicago, Ill. " Blue Ribbon Dairy Feed "	Basom	G 25.	4.	9.	Wheat bran, cottonseed meal, malt sprouts, molasses, hominy feed, oat meal mill by-products (oat middlings, oat hulls, oat shorts).
			F 23.7	4.53	10.57	Wheat bran, cottonseed meal, malt sprouts, hominy feed, cracked corn, oat clippings containing chaffy materials from oats, molasses.

1836	The Quaker Oats Co., Chicago, Ill. "Blue Ribbon Dairy Feed"	Randolph	G	25.	4.	9.	Wheat, corn, cottonseed meal, malt sprouts, molasses, hominy feed, oat meal by-products (oat middlings, oat hulls, oat shorts).
			F	25.7	4.91	10.16	Wheat bran, cottonseed meal, malt sprouts, hominy feed, oat clippings containing chaffy materials from oats, molasses.
5416	The Quaker Oats Co., Chicago, Ill. "Blue Ribbon Dairy Feed"	Albany	G	25.	4.	8.	Wheat bran, cottonseed meal, malt sprouts, molasses, hominy feed, and oat clippings.
			F	25.	5.03	9.25	Wheat bran, cottonseed meal, malt sprouts, hominy feed, oat hulls, molasses.
5147	The Quaker Oats Co., Chicago, Ill. "Daisy Dairy Feed"	Little Valley	G	16.	3.5	14.	Molasses, malt sprouts, cottonseed meal, oat meal mill by-products (oat middlings, oat shorts, oat hulls), grain screenings meal, flax plant by-product.
			F	15.8	4.47	15.83	Malt sprouts, cottonseed meal, oat shorts, oat middlings, oat hulls, grain screenings containing a large amount of weed seeds partly ground, flax plant by-product, molasses.
5156	The Quaker Oats Co., Chicago, Ill. "Daisy Dairy Feed"	Middletown	G	16.	3.5	14.	Malt sprouts, molasses, cottonseed meal, oat meal mill by-product (oat middlings, oat hulls, oat shorts), grain screenings meal, and flax plant by-product.
			F	16.6	4.55	16.44	Malt sprouts, cottonseed meal, oat shorts, oat middlings, oat hulls, grain screenings containing a large amount of weed seeds partly ground, flax plant by-product, molasses.

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ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
	MOLASSES FEEDS (COMPOUNDED) (*continued*):		*Per ct.*	*Per ct.*	*Per ct.*	
5157	The Quaker Oats Co., Chicago, Ill. "Daisy Dairy Feed"	Middletown	G* 16.	4.	16.	Molasses, cottonseed meal, oat meal mill by-products (oat middlings, oat shorts, oat hulls), grain screenings meal and flax plant by-product.
			F* 16.1	4.41	16.32	Malt sprouts, cottonseed meal, oat shorts, oat middlings, oat hulls, grain screenings containing a large amount of weed seeds partly ground, flax plant by-product, molasses.
3876	The Quaker Oats Co., Chicago, Ill. "Green Cross Horse Feed"	Hicksville	G 10.	3.25	10.5	Alfalfa meal, ground corn, crushed oats, molasses, cottonseed meal, oat meal mill by-product (oat middlings, oat hulls, oat shorts).
			F 9.5	2.83	7.86	Alfalfa meal, cracked corn, crushed oats, oat shorts, oat hulls, meat meal, molasses.
5324	The Quaker Oats Co., Chicago, Ill. "Green Cross Horse Feed" (Molasses Mixed Feed)	Buffalo	G 10.	3.25	10.5	Made from alfalfa meal, ground corn, crushed oats, molasses, oat meal mill by-products (oat middlings, oat hulls, oat shorts) and cottonseed meal.
			F 10.4	2.86	7.95	Alfalfa meal, ground corn, crushed oats, oat middlings, oat shorts, oat hulls, cottonseed meal, molasses.

4068	The Quaker Oats Co., Chicago, Ill. "Quaker Dairy Molasses Feed"	Fort Plain	G	16.	3.5	14.	Molasses, malt sprouts, cottonseed meal, grain screenings meal, flax plant by-products, oat meal mill by-products (oat middlings, oat hulls, oat shorts).
			F	16.	4.94	15.67	Cottonseed meal, malt sprouts, grain screenings containing weed seeds partly ground, flax plant by-product, oat middlings, oat shorts, oat hulls, molasses.
5018	The Quaker Oats Co., Chicago, Ill. "Quaker Molasses Dairy Feed"	Bloomville	G	16.	3.5	14.	Cottonseed meal, malt sprouts, molasses, grain screenings meal, flax plant by-product, oat meal mill by-products (oat middlings, oat hulls, oat shorts).
			F	15.8	4.53	17.37	Cottonseed meal, malt sprouts, grain screenings containing weed seeds partly ground, flax plant by-product, oat middlings, oat shorts, oat hulls, molasses.
5124	The Quaker Oats Co., Chicago, Ill. "Quaker Molasses Dairy Feed"	Alden	G	16.	3.5	14.	Cottonseed meal, malt sprouts, molasses, grain screenings meal, flax plant by-product, oat meal mill by-products (oat middlings, oat hulls, oat shorts).
			F	15.9	4.69	16.84	Cottonseed meal, malt sprouts, screenings containing weed seeds partly ground, flax plant by-product, oat middlings, oat shorts, oat hulls, molasses.
4981	Ralston Purina Co., St. Louis, Mo. "Purina Dairy Feed"	Albany	G	17.	3.	14.	Cottonseed meal, brewers' dried grains, hominy feed, ground alfalfa and molasses, three-fourths of 1 per cent salt.
			F	16.3	3.12	11.31	As certified.
4980	Ralston Purina Co., St. Louis, Mo. "Purina Molasses Feed"	Albany	G	10.	2.5	12.	Cracked corn, whole oats, ground alfalfa and molasses.
			F	9.4	2.6	10.	As certified.

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ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
	MOLASSES FEEDS (COMPOUNDED) (*continued*):		*Per ct.*	*Per ct.*	*Per ct.*	
5249	Ralston Purina Co., St. Louis, Mo. "Purina Molasses Feed"	Syracuse	G* 10.	2.5	12.	Cracked corn, whole oats, ground alfalfa, and molasses.
			F* 12.9	2.86	10.17	As certified.
3877	Robinson-Danforth Co., St. Louis, Mo. "Winner Molasses Feed"	Roslyn	G 10.	2.3	12.5	Cracked corn, whole oats, ground alfalfa and molasses.
			F 10.	2.34	9.28	As certified.
4624	The Sugarine Co., Chicago, Ill. "Sugarine Dairy Feed"	Antwerp	G 16.5	3.5	12.	Cottonseed meal, gluten feed, molasses, oat clippings, and ground and bolted grain screenings one-half of 1 per cent salt.
			F 18.97	6.04	9.77	As certified.
4725	The Sugarine Co., Chicago, Ill. "Sugarine Dairy Feed"	Binghamton	G 16.5	3.5	12.	Cottonseed meal, gluten feed, molasses, oat clippings, and ground and bolted grain screenings, one-half of 1 per cent salt.
			F 17.7	6.34	8.49	Cottonseed meal, cornstarch by-product with corn bran, oat clippings and ground grain screenings, salt, molasses.
4952	The Sugarine Co., Chicago, Ill. "Sugarine Dairy Feed"	Delanson	G 16.5	3.5	12.	Cottonseed meal, gluten feed, molasses, oat clippings and ground and bolted grain screenings, one-half of 1 per cent salt.
			F 18.4	5.09	9.42	Cottonseed meal, cornstarch by-product with corn bran, oat clippings and ground grain screenings, salt, molasses.

4964	The Sugarine Co., Chicago, Ill. "Sugarine Dairy Feed"	Johnstown	G	16.5	3.5	12.	Cottonseed meal, gluten feed, molasses, oat clippings, and ground and bolted grain screenings, one-half of 1 per cent salt.
			F	16.3	6.00	11.17	Cottonseed meal, cornstarch by-product with corn bran, oat clippings, and ground grain screenings, salt, molasses.
5120	The Sugarine Company, Chicago, Ill. "Sugarine Dairy Feed"	Olean	G	16.5	3.5	12.	Cottonseed meal, gluten feed, molasses, oat clippings and ground and bolted grain screenings, one half of 1 per cent salt.
			F	16.4	3.76	10.06	Cottonseed meal, cornstarch by-product with corn bran, oat clippings and ground grain screenings, salt, molasses.
5080	The Sugarine Co., Chicago, Ill. "Sugarine Mixing Feed"	Sauquoit	G	12.	2.5	12.	Gluten feed, molasses, oat clippings and ground and bolted grain screenings, one-half of 1 per cent salt.
			F	12.9	3.99	11.15	Cottonseed meal,cornstarch by-product with corn bran, oat clippings, ground grain screenings, salt, molasses.
4627	United States Sugar Feed Co., Milwaukee, Wis. "U. S. Sugar Feed"	Pulaski	G	13.	3.	12.	Cottonseed meal, molasses, oat clippings, flax plant by-product, ground and bolted grain screenings and a small percentage of salt.
			F	13.8	6.06	14.55	As certified.
4992	United States Sugar Feed Co., Milwaukee, Wis. "U. S. Sugar Feed"	Montgomery	G	15.	3.	12.	
			F	16.5	3.68	6.43	Cottonseed meal, alfalfa meal, charred grain, oat clippings, ground grain screenings, molasses.

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ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
	MOLASSES FEEDS (COMPOUNDED) (*continued*):		*Per ct.*	*Per ct.*	*Per ct.*	
5045	United States Sugar Feed Co., Milwaukee, Wis. "U. S. Sugar Feed"	Cortland	G* 15.	3.	12.	Cottonseed meal, wheat, corn, oats, malt sprouts, screenings, alfalfa meal and molasses.
			F* 15.3	2.68	8.94	Cottonseed meal, alfalfa meal, malt sprouts, charred grain, oat clippings, ground grain screenings, molasses.
5160	United States Sugar Feed Co., Milwaukee, Wis. "U. S. Sugar Feed"	Westtown	G 13.	3.	12.	
			F 14.	6.01	16.57	Cottonseed meal, ground grain screenings, oat clippings, flax plant by-product, molasses, salt.
5243	United States Sugar Feed Co., Milwaukee, Wis. "U. S. Sugar Feed"	Groton	G 13.	3.	12.	Cottonseed meal, molasses, oat clippings, flax plant by-product, ground and bolted grain screenings and a small percentage of salt.
			F 16.5	6.18	10.54	As certified.
5175	The Otto Weiss Alfalfa Stock Food Co., Wichita, Kan. "Otto Weiss Sweet Feed No. 4"	Newburgh	G 10.	2.	15.	Alfalfa, cracked corn, oats and cane molasses.
			F 11.28	3.14	11.56	As certified.
4691	Western Grain Products Co., Hammond, Ind. "Hammond Dairy Feed"	Johnsonburg	G 16.5	3.5	11.	Cottonseed meal, distillers' grains, malt sprouts and ground corn, oats, barley and wheat screenings and molasses.
			F 16.3	3.73	11.51	Cottonseed meal, distillers' grains, malt sprouts, grain screenings, salt, molasses.

5021	The Western Grain Products Co., Hammond, Ind. "Hammond Dairy Feed"	Unadilla	G	16.5	3.5	11.	Three-tenths of 1 per cent salt, cottonseed meal, distillers' grains, malt sprouts and ground corn, oat, barley and wheat screenings and molasses.
			F	16.8	3.7	10.26	Cottonseed meal, distillers' grains, malt sprouts, grain screenings, salt, molasses.
5122	Western Grain Products Co., Hammond, Ind. "Hammond Dairy Feed"	Portville	G	16.5	3.5	11.	Cottonseed meal, distillers' grains, malt sprouts and ground corn, oat, barley and wheat screenings and molasses.
			F	18.5	4.32	9.89	Cottonseed meal, distillers' grains, malt sprouts, grain screenings, salt, molasses.
4695	W. J. Wheelock Co.. Greigsville, N. Y. "Banner Dairy Feed"	North Java	G	18.	4.	10.	Gluten feed, cottonseed meal, corn meal, oil meal, oat clips, wheat middlings, distillers' grains, malt sprouts, salt three-fourths of 1 per cent., and molasses.
			F	20.9	4.11	7.43	Cornstarch by-product with corn bran, cottonseed meal, corn meal, linseed meal, distillers' grains, wheat middlings, malt sprouts, clipped oat refuse, salt, molasses.
5111	W. J. Wheelock Co., Greigsville, N. Y. "Banner Dairy Feed"	Franklinville	G	18.	4.	10.	Gluten feed, cottonseed meal, corn meal, oil meal, oat clips, wheat middlings, distillers' grains, malt sprouts, salt three-fourths of 1 per cent., and molasses.
			F	23.5	4.05	6.94	Cornstarch by-product with corn bran, cottonseed meal, corn meal, linseed meal, distillers' grains, wheat middlings, malt sprouts, clipped oat refuse, salt, molasses.

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ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.		Crude protein.	Crude fat.	Crude fiber.	Ingredients.
				Per ct.	*Per ct.*	*Per ct.*	
	COTTONSEED FEEDS:						
4692	F. W. Brode & Co., Memphis, Tenn.		G*	22.	5.	28.	Ground cotton seed.
	"Fox Brand Standard Cotton Seed Feed"	Johnsonburg	F*	24.5	4.63	17.14	Cottonseed meal, cottonseed hulls.
5024	Florida Cotton Oil Co., Jacksonville, Fla.		G	25.	6.	20.	Made from Sea Island cottonseed meal and cottonseed hulls.
	"Durham Brand Sea Island Cotton Seed Feed"	Unadilla	F	24.8	7.38	16.24	As certified.
4727	Humphreys Godwin Co., Memphis, Tenn.		G	20.	5.	22.	Choice cottonseed meal and cottonseed hull bran.
	"Creamo Brand Cotton Seed Feed"	Binghamton	F	21.6	4.36	19.29	Cottonseed meal, cottonseed hulls.
5025	The Southern Cotton Oil Co., Charlotte, N. C.		G	17.	3.	40.	Cottonseed hulls and meal.
	"Boveta Brand Cotton Seed Hull and Meal Mixture"	Walton	F	14.8	2.75	28.54	As certified.
5058	The Southern Cotton Oil Co., Charlotte, N. C.		G	17.	3.	40.	
	"Boveta Cotton Seed Hull and Meal Mixture"	Clinton	F	15.9	3.76	28.31	Cottonseed meal and cottonseed hulls.
5073	Southern Fibre Co., Portsmouth, Va.		G	10.	1.8	35.	Cottonseed hulls and cottonseed meal.
	"'Jersey Cow' Feed"	Plattsburg	F	9.7	1.74	30.21	As certified.
5074	Southern Fibre Co., Portsmouth, Va.		G	16.	3.1	32.	Cottonseed meal and cottonseed hulls.
	"'Ko-Bos' Dairy Feed"	Plattsburg	F	14.6	2.62	27.18	Cottonseed hulls and cottonseed meal.

5141	Southern Fibre Co., Portsmouth, Va. " 'Ko-Bos' Dairy Feed "	Lockport	G	16.	3.1	32.	Cottonseed meal and cottonseed hulls.
			F	13.3	2.41	26.99	Cottonseed meal and cottonseed hulls.
4710	Southern Fibre Co., Portsmouth, Va. " Royal Feed "	Union	G	22.	4.	22.	Cottonseed meal and cottonseed hulls.
			F	18.5	3.59	24.11	As certified.
4768	Southern Fibre Co., Portsmouth, Va. " Royal Feed "	Albany	G	22.	4.	22.	Cottonseed meal and cottonseed hulls.
			F	25.2	4.26	20.21	As certified.
5150	Tennessee Fibre Co., Memphis, Tenn. " Creamo Brand Cotton Seed Feed "	Alfred	G	20.	5.	22.	Choice cottonseed meal and cottonseed hull bran.
			F	22.6	4.49	20.25	Cottonseed meal and cottonseed hulls.
	POULTRY FOODS—COMPOUNDED:						
5218	American Milling Co., Chicago, Ill. " Amco Chick Feed "	Owego	G	10.	3.	5.	Cracked corn, cracked wheat, cracked kaffir corn, millet seed and linseed oil cake.
			F	12.6	2.83	2.53	As certified.
5404	American Milling Co., Chicago, Ill. " Amco Hen Feed "	Ravena	G	10.	3.	5.	Corn, wheat, barley, kaffir corn, linseed oil cake, sunflower seed and buckwheat.
			F	11.2	3.27	2.46	Corn, wheat, barley, oats, kaffir corn, linseed meal, sunflower seeds, buckwheat.
4908	Blatchford's Calf Meal Factory, Waukegan, Ill. " Blatchford's Egg Mash "	Warsaw	G	19.	4.	10.	Containing milk and milk substitute, Blatchford's calf meal, dried milk, barley meal, beef scraps, alfalfa, corn meal, oat meal, fish, pepper, oil meal.
			F	20.	4.19	9.83	Dried milk, barley, meat and bone scrap, alfalfa, corn meal, oats, fish scrap, linseed meal, wheat bran, rice hulls, ground cocoa shells, locust bean meal, wheat flour, flaxseed, cottonseed meal, ground beans and lentils, pepper, fenugreek, salt.

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ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
	POULTRY FOODS—COMPOUNDED (*continued*):		*Per ct.*	*Per ct.*	*Per ct.*	
5302	Blatchford's Calf Meal Factory, Waukegan, Ill. "Blatchford's Fill the Basket Egg Mash"	Buffalo	G* 20.	1.	10.75	Blatchford's calf meal, dried milk, barley meal, beef scraps, alfalfa, corn meal, fish, pepper, oil meal.
			F* 19.2	3.77	8.91	Dried milk, barley, meat and bone scrap, alfalfa, corn meal, oats, fish scrap, linseed meal, wheat bran, rice hulls, ground cocoa shells, locust bean meal, wheat flour, flaxseed, cottonseed meal, ground beans and lentils, pepper, fenugreek, salt.
3856	Brooklyn Elevator & Milling Co., Brooklyn, N. Y. "Bemco Poultry Mash"	Brooklyn	G 12.	3.	5.	
			F 13.5	3.19	3.61	Wheat bran, wheat middlings, corn, hominy feed, cornstarch by-product without corn bran, linseed meal, Hen-e-ta grits.
5010	Buffalo Cereal Co., Buffalo, N. Y. "Bufceco Poultry Feed"	Oneonta	G 15.	4.	5.	Corn, hominy feed, wheat bran, wheat middlings, gluten feed, rolled oats.
			F 15.5	5.26	4.95	Corn, hominy feed, wheat bran, wheat middlings, corn starch by-product with corn bran, rolled oats.
5054	Buffalo Cereal Co., Buffalo, N. Y. "Bufceco Poultry Feed"	Utica	G 15.	4.	5.	Corn, hominy feed, wheat bran, wheat middlings, gluten feed, rolled oats.
			F 15.7	5.38	5.4	Corn, hominy feed, wheat bran, wheat middlings, cornstarch by-product with corn bran, rolled oats.

5128	Buffalo Cereal Co., Buffalo, N. Y. "Bufceco Poultry Feed"	Alden	G	15.	4.	5.	Corn, hominy feed, wheat bran, wheat middlings, gluten feed, rolled oats.
			F	15.2	5.37	4.59	Corn, hominy feed, wheat bran, wheat middlings, cornstarch by-product with corn bran, rolled oats.
5136	Buffalo Poultry Supply Co., Buffalo, N. Y. "Buffalo Brand Laying Mash"	Buffalo	G	15.	4.	13.	Wheat bran, wheat middlings, corn meal, gluten meal, alfalfa, beef scrap, red dog flour, oil meal and ground oats.
			F	16.1	4.16	5.07	Wheat bran, wheat middlings, corn meal, cornstarch by-product with corn bran, alfalfa meal, beef scraps, red dog flour, linseed meal, ground oats.
5134	Cyphers Incubator Co., Buffalo, N. Y. "Cyphers Fattening Mash"	Buffalo	G	11.	3.	5.	Kaffir meal, wheat bran, red dog flour, wheat middlings, corn meal and alfalfa meal.
			F	10.9	3.76	2.6	Corn meal, kaffir meal, wheat bran, wheat middlings, red dog flour.
5329	Cyphers Incubator Co., Buffalo, N. Y. "Fertile Egg Mash"	Buffalo	G	10.	3.	12.	Contains bran, middlings, corn meal, alfalfa meal, ground oats.
			F	10.7	3.71	3.77	Wheat bran, wheat middlings, corn meal, alfalfa meal, ground oats.
3883	Cyphers Incubator Co., Buffalo, N. Y. "Growing Mash"	Peekskill	G	10.	3.	10.	Ground oats, corn meal, wheat middlings, alfalfa meal, bone and meat meal.
			F	14.5	3.82	3.25	Ground oats, corn meal, kaffir meal, wheat middlings, alfalfa meal, meat and bone meal.
5135	Cyphers Incubator Co., Buffalo, N. Y. "Cyphers Growing Mash"	Buffalo	G	10.	3.	10.	Ground oats, corn meal, wheat middlings, alfalfa meal, bone and meat meal.
			F	13.9	4.77	3.34	As certified.

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ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
	POULTRY FOODS—COMPOUNDED (*continued*)		*Per ct.*	*Per ct.*	*Per ct.*	
4903	Cyphers Incubator Co., Buffalo, N. Y. "Laying Mash"	Geneseo	G* 15.	3.	6.	Kaffir meal, wheat bran, red dog, wheat middlings, blood meal, corn meal, alfalfa meal.
			F* 15.6	4.56	3.98	Kaffir meal, wheat bran, wheat middlings, red dog flour, blood meal, corn meal.
5133	Cyphers Incubator Co., Buffalo, N. Y. "Cyphers Laying Mash"	Buffalo	G 15.	3.	6.	Kaffir meal, wheat meal, red dog, wheat middlings, corn meal, alfalfa meal, blood meal.
			F 15.	4.07	5.84	Kaffir meal, wheat bran, wheat middlings, red dog flour, blood meal, corn meal.
4916	C. C. Davison, Geneva, N. Y. "Chicken Mash"	Geneva	G ——	——	——	Corn meal, middlings, bran, alfalfa meal, oil meal, beef scraps.
			F 17.1	5.14	6.24	Corn meal, wheat bran, wheat middlings, alfalfa meal, linseed meal, beef scraps.
4688	The Albert Dickinson Co., Chicago, Ill. "Queen Poultry Mash"	Varysburg	G 11.	2.5	10.	Alfalfa meal, corn feed meal, wheat meal.
			F 10.7	2.97	6.56	Alfalfa meal, corn feed meal, corn bran, kaffir corn, wheat meal, wheat bran, small amount of beef scrap, linseed meal, salt.

4991	The Albert Dickinson Co. Chicago, Ill. "Queen Poultry Mash"	Kingston	G	11.	2.5	10.	Alfalfa meal, corn feed meal, wheat meal, ground corn bran, wheat bran, beef scrap, oil cake, salt one-half of 1 per cent.
			F	11.5	3.11	5.44	Alfalfa meal, corn feed meal, corn bran, kaffir corn, wheat meal, wheat bran, small amount of beef scrap, linseed meal, barley, salt.
5008	The Albert Dickinson Co., Chicago, Ill. "Queen Poultry Mash"	Oneonta	G	11.	2.5	10.	Alfalfa meal, corn feed meal wheat meal, ground corn bran, wheat bran, beef scraps, oil cake, salt one-half of 1 per cent.
			F	10.8	4.52	5.72	Alfalfa meal, corn feed meal, corn bran, kaffir corn, wheat meal, wheat bran, small amount of beef scrap, linseed meal, barley, salt.
5078	Geo. F. Dudley & Co., Ticonderoga, N. Y. "Chicken Mash"	Ticonderoga	G	——	——	——	Alfalfa meal, beef scraps, bran, middlings, corn meal, ground oats, and linseed meal.
			F	21.28	3.97	10.48	As certified.
4762	R. D. Eaton Grain & Feed Co., Norwich, N. Y. "Eaton's Perfection Mash Mixture for Laying Fowls"	Albany	G	20.	4.	8.	Alfalfa meal, milk albumen, milo maize meal, beef scrap, charcoal, winter wheat bran, kaffir corn meal, granulated bone, whole wheat flour, linseed oil meal, gluten, pea meal, bone flour, sodium chloride, ground oats, Hen-e-ta grits.
			F	17.4	4.02	8.71	Alfalfa meal, milk albumen, kaffir corn meal, beef scraps, charcoal, wheat bran, granulated bone, wheat flour, linseed meal, cornstarch by-product with corn bran, pea meal, bone meal, ground oats, Hen-e-ta grits, salt.

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ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
			Per ct.	*Per ct.*	*Per ct.*	
	POULTRY FOODS—COMPOUNDED (*continued*)					
5032	R. D. Eaton Grain & Feed Co., Norwich, N. Y. "Eaton's Perfection Mash Mixture for Laying Fowls"	Delhi	G* 20.	4.	8.	Alfalfa meal, milk albumen, milo maize meal, beef scrap, charcoal, winter wheat bran, kaffir corn meal, granulated bone, whole wheat flour, linseed oil meal, gluten, pea meal, bone flour, sodium chloride, ground oats, Hen-e-ta grits.
			F* 18.3	4.17	9.4	Alfalfa meal, milk albumen, kaffir corn meal, beef scraps, wheat bran, charcoal, wheat flour, granulated bone, linseed meal, cornstarch by-product with corn bran, pea meal, bone meal, ground oats, Hen-e-ta grits, salt.
5094	R. D. Eaton Grain & Feed Co., Norwich, N. Y. "Eaton's Perfection Mash Mixture for Laying Fowls"	Cleveland	G 20.	4.	8.	Alfalfa meal, milk albumen, milo maize meal, beef scraps, charcoal, winter wheat bran, kaffir corn meal, granulated bone, whole wheat flour, linseed oil meal, gluten, pea meal, bone flour, sodium chloride, ground oats, Hen-e-ta grits.
			F 17.6	5.19	9.21	Alfalfa meal, milk albumen, kaffir corn meal, milo maize meal, beef scraps, charcoal, wheat bran, wheat flour, granulated bone, linseed meal, corn starch by-product with corn bran pea meal, bone meal, ground oats, Hen-e-ta grits, salt.

5401	D. Eddy & Son, Saratoga, N. Y. "Hen-e-ta Mash"	Saratoga	G	12.	3.	4.	Hen-e-ta, corn meal, wheat middlings, wheat bran, gluten, linseed meal, pea meal.
			F	14.28	3.49	3.43	As certified.
3878	William Germuth, Richmond Hill, N. Y. "Dunton Poultry Mash"	Lynbrook	G	17.38	4.64	7.3	Alfalfa meal, wheat middlings, wheat bran, rolled oats, linseed meal, corn meal, meat scrap.
			F	17.1	5.31	9.09	Alfalfa meal, wheat bran, wheat middlings, ground corn, meat meal, linseed meal.
4888	Globe Elevator Co., Buffalo, N. Y. "Blue Ribbon Laying Mash"	Macedon	G	15.	4.	10.	Wheat bran, wheat middlings, wheat flour, rolled oats, corn meal, gluten meal, oil meal, alfalfa meal, beef scrap.
			F	18.5	4.71	6.15	Wheat bran, wheat middlings, wheat flour, rolled oats, corn meal, cornstarch by-product without corn bran, linseed meal, alfalfa meal, beef scraps.
5227	Globe Elevator Co., Buffalo, N. Y. "Blue Ribbon Laying Mash"	Lestershire	G	15.	4.	10.	Wheat bran, wheat middlings, wheat flour, rolled oats, corn meal, gluten meal, oil meal, alfalfa meal, beef scrap.
			F	18.3	4.3	8.73	Wheat bran, wheat middlings, wheat flour, rolled oats, corn meal, cornstarch by-product without corn bran, linseed meal, alfalfa meal, beef scraps.
4907	Harvey Seed Co., Buffalo, N. Y. "Electric Poultry Food"	Silver Springs	G	12.	3.	——	Corn meal, wheat middlings, gluten feed, cottonseed meal, wheat bran and oil meal.
			F	14.	5.4	3.96	Corn meal, wheat middlings, cornstarch by-product with corn bran, cottonseed meal, wheat bran, linseed meal.

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ANALYSES OF SAMPLES OF FEEDING STUFFS (continued).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
	POULTRY FOODS—COMPOUNDED (*continued*)		*Per ct.*	*Per ct.*	*Per ct.*	
5307	Harvey Seed Co., Buffalo, N. Y. "Electric Poultry Food"	Dunkirk	G* 12.	3.	——	Corn meal, wheat middlings, gluten feed, cottonseed meal, wheat bran and oil meal.
			F* 14.2	4.4	3.44	Corn meal, wheat bran, wheat middlings, cornstarch by-product with corn bran, cottonseed meal, linseed meal.
5248	The Hen-ty Mfg. Co., Auburn, N. Y. "The Hen-ty Laying Mash"	Weedsport	G 16.	5.	6.	Linseed meal, cottonseed meal, corn meal, ground oats, wheat bran, wheat middlings, gluten feed, hominy meal, fish scrap, beef scrap, bone meal, meat meal, oyster shell meal, alfalfa meal, charcoal.
			F 19.6	6.1	5.55	Linseed meal, cottonseed meal, corn meal, ground oats, oat hulls, wheat bran, wheat middlings, corn starch by-product with corn bran, hominy feed, fish scrap, beef scrap, bone meal, meat meal, ground oyster shells, alfalfa meal, charcoal.
5087	A. H. Herrick & Son, Watertown, N. Y. "Hen-o-la Mash Food"	Watertown	G 12.68	2.32	4.96	Meal, gluten feed, midds, bran, Hen-e-ta.
			F 12.5	3.5	3.91	Corn meal, cornstarch by-product with corn bran, wheat middlings, wheat bran, Hen-e-ta grits.
4737	The H-O Company, Buffalo, N. Y. "The H-O Co's Algrane Scratching Feed"	Syracuse	G 11.	3.5	9.	Wheat, oats, kaffir corn, buckwheat, mixed broken grains, cracked corn, milo maise, sunflower seed, hulled oats.
			F 11.8	4.01	2.06	As certified.

4789	The H-O Company, Buffalo, N. Y. "The H-O Co's Algrane Scratching Feed"	Middleburg	G	11.	3.5	9.	Wheat, oats, kaffir corn, buckwheat, mixed broken grains, cracked corn, milo maize, sunflower seed, hulled oats.
			F	10.9	3.7	2.27	As certified.
3870	The H-O Company, Buffalo, N. Y. "The H-O Co's Chick Feed"	Brooklyn	G	12.	3.	9.	Corn, cut oat meal, cracked wheat, kaffir corn, peas, millet.
			F	11.9	3.32	2.13	Broken grains of corn, oats, wheat, kaffir corn, peas and millet.
4739	The H-O Company, Buffalo, N. Y. "The H-O Co's Chick Feed"	Syracuse	G	12.	3.	9.	Corn, cut oat meal, cracked wheat, kaffir corn, peas, millet.
			F	13.2	3.95	2.06	Broken grains of corn, oats, wheat, kaffir corn, peas and millet.
4773	The H-O Company, Buffalo, N. Y. "The H-O Co's Dry Poultry Mash"	Troy	G	20.	3.5	9.	Oat midds, gluten feed, wheat midds, rolled oats, alfalfa, corn, hominy feed, cracked wheat, wheat bran.
			F	18.	3.92	10.43	Oat middlings, corn starch by-product with corn bran, wheat, wheat bran, wheat middlings, alfalfa, rolled oats, corn, hominy feed, salt.
5454	The H-O Company, Buffalo, N. Y. "The H-O Co's Dry Poultry Mash"	Buffalo	G	20.	3.5	9.	Oat middlings, gluten feed, wheat midds, rolled oats, alfalfa, corn, hominy feed, cracked wheat, wheat bran.
			F	16.2	4.02	11.09	Cornstarch by-product with corn bran, oat middlings, wheat middlings, rolled oats, alfalfa, corn, hominy feed, wheat.
4772	The H-O Company, Buffalo, N. Y. "The H-O Co's Poultry Feed"	Troy	G	17.	5.5	9.	Oat middlings, rolled oats, gluten, wheat bran, wheat middlings, hominy feed.
			F	17.2	5.05	6.11	Oat middlings, rolled oats, cornstarch by-product with corn bran, wheat bran, wheat middlings, hominy feed.

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ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
	POULTRY FOODS—COMPOUNDED (*continued*)		*Per ct.*	*Per ct.*	*Per ct.*	
4864	The H-O Company, Buffalo, N. Y. "The H-O Co's Poultry Feed"	Canandaigua	G* 17.	5.5	9.	Oat middlings, rolled oats, gluten feed, wheat bran, wheat middlings, hominy feed.
			F* 18.	5.3	6.19	Oat middlings, rolled oats, cornstarch by-product with corn bran, wheat bran, wheat middlings, hominy feed.
5457	The H-O Company, Buffalo, N. Y. "The H-O Co's Steam Cooked Chick Feed"	Buffalo	G 12.	3.	9.	Corn, cut oatmeal, cracked wheat, kaffir corn, peas, millet.
			F 12.1	3.64	1.85	Oat groats, cracked wheat, kaffir corn, millet, cracked corn, a few weed seeds.
4649	Husted Milling Co., Buffalo, N. Y. "Husted Laying Mash"	Watertown	G 15.	3.	8.	Corn meal, rolled oats, wheat bran, wheat middlings, cottonseed meal, gluten feed.
			F 15.85	5.53	5.25	Corn meal, rolled oats, wheat bran, wheat middlings, cottonseed meal, cornstarch by-product with corn bran, salt.
4881	Husted Milling Co., Buffalo, N. Y. "Husted Laying Mash"	Rochester	G 15.	3.	8.	Corn meal, rolled oats, wheat bran, wheat middlings, cottonseed meal, gluten feed.
			F 16.9	6.04	5.65	Corn meal, rolled oats, wheat bran, wheat middlings, cottonseed meal, cornstarch by-product with corn bran, salt.

4962	Husted Milling Co., Buffalo, N. Y. "Husted Laying Mash"	Gloversville	G	15.	3.	8.	Bran, middlings, corn, rolled oats, cottonseed meal.
			F	15.6	5.21	5.91	Wheat bran, wheat middlings, corn, rolled oats, cottonseed meal, cornstarch by-product with corn bran, salt.
5334	Husted Milling Co., Buffalo, N. Y. "Husted Poultry Feed"	Buffalo	G	12.	4.	9.	Bran, middlings, corn, gluten, alfalfa.
			F	14.5	5.11	6.86	Wheat bran, wheat middlings, corn, cornstarch by-product with corn bran, alfalfa.
5552	The Illinois Seed Co., Chicago, Ill. "Phoenix Poultry Feed"	Albany	G	10.	2.5	5.	Wheat, barley, oats, kaffir corn, corn, buckwheat, millet, sunflower, oil cake.
			F	11.4	3.29	2.16	Barley, oats, wheat, kaffir corn, corn, buckwheat, sunflower seeds, oil cake.
5201	Jamestown Electric Mills, Jamestown, N. Y. "Purity Poultry Mash"	Elmira	G	12.	3.	3.5	Corn meal, diamond gluten, wheat middlings, wheat bran, O. P. oil meal, pea meal and Hen-e-ta.
			F	14.9	2.99	4.13	Corn meal, cornstarch by-product with corn bran, wheat bran, wheat middlings, linseed meal, pea meal, Hen-e-ta grits.
4897	Mystic Milling and Feed Co., Rochester, N. Y. "Puritan Growing Mash"	Rochester	G	14.	3.	8.	Wheat bran, wheat middlings, corn meal, gluten feed, alfalfa meal, bone meal, meat meal.
			F	15.9	3.8	4.77	Wheat bran, wheat middlings, corn meal, cornstarch by-product without corn bran, alfalfa meal, bone meal, meat meal.
4896	Mystic Milling and Feed Co., Rochester, N. Y. "Puritan Laying Mash"	Rochester	G	23.	7.	8.	Gluten, oil meal, bran, corn meal, middlings, alfalfa meal, bone meal, meat meal.
			F	25.7	4.79	7.18	Cornstarch by-product with corn bran, linseed meal, wheat bran, wheat middlings, corn meal, alfalfa meal, animal meal, bone meal.

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ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
	POULTRY FOODS—COMPOUNDED (*continued*)		*Per ct.*	*Per ct.*	*Per ct.*	
4979	Mystic Milling and Feed Co., Rochester, N. Y. "Puritan Laying Mash"	Schenectady	G* 23.	7.	8.	Gluten, oil meal, bran, corn meal, middlings, alfalfa meal, bone meal, meat meal.
			F* 24.8	4.8	5.57	Cornstarch by-product with corn bran, linseed meal, wheat bran, wheat middlings, corn meal, alfalfa meal, meat meal, bone meal.
4919	The Ontario Roller Mills, Canandaigua, N. Y. "Hen-o-la Mash Food"	Canandaigua	G ——	——	——	Corn meal, bran, middlings, oil meal, gluten feed, Hen-e-ta grits.
			F 17.1	3.93	5.37	Corn meal, wheat bran, wheat middlings, linseed meal, cornstarch by-product with corn bran, Hen-e-ta grit.
5183	Wm. Orr & Sons, Orr's Mills, N. Y. "Orr's Digestible Mash"	Orr's Mills	G 8.	2.	15.	Corn meal, wheat bran, wheat middlings, beef scrap, oyster shells, beet pulp, ground oats, gluten, bone meal, salt.
			F 17.2	4.47	5.58	Corn meal, wheat bran, wheat middlings, beef scraps, oyster shells, dried beet pulp, ground oats, cornstarch by-product with corn bran, bone meal, salt.
4760	The Park & Pollard Co., Boston, Mass. "Dry Mash Feed"	Albany	G 20.	3.	10.	Corn, wheat, oats, barley, bran, middlings, meat meal, fish, alfalfa and salt.
			F 20.3	5.1	7.11	Corn meal, wheat, wheat bran, wheat middlings, oats, oat hulls, barley, meat meal, fish scraps, alfalfa, ground screenings, salt.

5019	The Park & Pollard Co., Boston, Mass. "Dry Mash Feed"	East Meredith	G	20.	3.	10.	Bran, middlings, corn, wheat, barley, alfalfa, fish, meat, bone and salt.
			F	19.2	4.72	9.12	Corn meal, wheat, wheat bran, wheat middlings, oats, oat hulls, barley, meat meal, fish scraps, alfalfa, ground screenings, salt.
5065	The Park & Pollard Co., Boston, Mass. "Dry-Mash Feed"	Malone	G	20.	3.	——	Composed of corn, wheat, oats, barley, bran, middlings, meat meal, fish, alfalfa and salt.
			F	17.2	4.1	9.79	Corn meal, wheat, wheat bran, wheat middlings, oats, oat hulls, barley, meat meal, fish scraps, alfalfa, ground screenings.
4761	The Park & Pollard Co., Boston, Mass. "Fattening Feed"	Albany	G	10.	3.	8.	Corn, wheat, barley, kaffir corn, oats and salt.
			F	11.5	4.56	7.47	Corn meal, kaffir corn, wheat, oats, barley, salt.
5067	The Park & Pollard Co., Boston, Mass. "Fattening Feed"	Malone	G	10.	3.	——	
			F	10.7	4.65	8.54	Corn meal, kaffir corn, wheat, oats, barley, salt.
4759	The Park & Pollard Co., Boston, Mass. "Growing Feed"	Albany	G	14.	3.12	10.	Corn, oats, wheat, barley, kaffir corn, meat meal and salt.
			F	16.8	6.11	4.62	Ground corn, ground kaffir corn, oats, ground wheat, ground barley, meat meal, ground wild buckwheat, salt.
5020	The Park & Pollard Co., Boston, Mass. "Growing Feed"	Grand Gorge	G	14.	3.12	——	Corn, oats, wheat, barley, kaffir corn, meat meal and salt.
			F	15.3	4.91	6.56	Ground corn, ground kaffir corn, oats, ground wheat, ground barley, meat meal, ground wild buckwheat, salt.
5066	The Park & Pollard Co., Boston, Mass. "Growing Feed"	Malone	G	10.	3.5	5.	Bran, middlings, corn, wheat, barley, alfalfa, fish, meat, bone and salt.
			F	14.3	4.75	5.09	Ground corn, ground kaffir corn, oats, ground wheat, ground barley, meat meal, ground wild buckwheat, salt.

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ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
	POULTRY FOODS—COMPOUNDED (*continued*)		*Per ct.*	*Per ct.*	*Per ct.*	
4988	Purina Mills, St. Louis, Mo. "Purina Chicken Chowder"	Kingston	G* 17.	3.	9.	Alfalfa meal, corn meal, bran, middlings, charcoal, granulated meat, linseed meal.
			F* 19.8	4.5	7.34	Alfalfa meal, corn meal, wheat bran, wheat middlings, charcoal, ground meat, linseed meal, salt.
5028	Purina Mills, St. Louis, Mo. "Purina Chicken Chowder"	Delhi	G 17.	3.	9.	Alfalfa meal, corn meal, bran, middlings, charcoal, granulated meat, linseed meal.
			F 18.1	3.94	6.08	Alfalfa meal, corn meal, wheat bran, wheat middlings, charcoal, ground meat, linseed meal, salt.
5197	Puritan-American Poultry Food Mfg. Co., Bound Brook, N. J. "Puritan Chick Food"		G 12.5	7.	6.	Corn, wheat, meat, oyster shell, sulphur, anise seed, charcoal and fenugreek.
		Hoosick Falls	F 13.8	7.21	5.17	As certified.
5234	Puritan-American Poultry Food Mfg. Co., Bound Brook, N. J. "Puritan Chick Food"		G 12.5	7.	6.	Corn, wheat, meat, oyster shell, sulphur, anise seed, charcoal and fenugreek.
		Oneida	F 13.5	7.06	4.66	As certified.
4996	The Quaker Oats Co., Chicago, Ill. "American Poultry Feed"	Goshen	G 12	3.5	9.	Corn, barley, cottonseed meal, wheat mixed feed and rye shorts.
			F 12.9	5.66	4.47	Corn, barley, cottonseed meal, wheat bran, wheat middlings, rye middlings.
5040	The Quaker Oats Co., Chicago, Ill. "American Poultry Feed"	Oxford	G 12.	3.5	———	
			F 12.8	5.67	4.49	Corn, barley, cottonseed meal, wheat bran, wheat middlings, rye middlings.

5170	The Quaker Oats Co., Chicago, Ill. "Schumacher Little Chick Feed"	Chester	G	10.	2.5	5.	Wheat, kaffir corn, millet, corn, oat groats and pigeon grass with not to exceed 6 per cent marble grit and one-half of 1 per cent poultry charcoal.
			F	10.6	2.58	1.75	As certified.
4699	The Quaker Oats Co., Chicago, Ill. "Schumacher Little Chick Feed"	Gainesville	G	10.	2.5	5.	Wheat, kaffir corn, millet, corn, oat groats and pigeon grass, and 6 per cent marble grit and one-half of 1 per cent poultry charcoal.
			F	11.	1.67	1.63	As certified.
3860	Stumpp & Walter Co., New York, N. Y. "Quality Kind Mash Food"	New York	G	15.	3.	12.	Ground corn, wheat and alfalfa, rolled oats, cotton seed meal, linseed meal, buckwheat middlings and meat meal.
			F	19.9	4.53	9.28	Ground corn, kaffir corn, wheat, alfalfa, rolled oats, cottonseed meal, linseed meal, buckwheat middlings, buckwheat hulls, meat meal.
5250	Tioga Mill & Elevator Co., Waverly, N. Y. "Tioga Dry Mash"	Waverly	G	13.	3.75	5.25	Corn meal, corn germ, linseed meal, wheat flour, wheat bran, gluten feed, wheat middlings, kaffir corn meal, phospho silicate of lime and soda.
			F	13.5	3.03	4.36	Corn meal, corn germ, linseed meal, wheat flour, wheat bran, wheat middlings, cornstarch 'by-product' with corn bran, kaffir corn meal, Hen-e-ta grit.
3863	The Van Iderstine Co., Long Island City, N. Y. "Darling's Mash Food for Poultry"	L. I. City	G	18.	3.5	10.	Cracked corn, beef scraps, blood meal, bone meal, alfalfa meal, wheat middlings, wheat bran, oyster shells, grit.
			F	18.1	4.33	4.9	As certified.

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ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
	POULTRY FOODS—COMPOUNDED (*continued*)		*Per ct.*	*Per ct.*	*Per ct.*	
5153	L. R. Wallace, Middletown, N. Y. "Mapes Balanced Ration for Poultry"	Middletown	G* 12.	4.	8.	Animal meal, ground bone, corn meal, middlings, bran, glüten, ground oats, alfalfa meal.
			F* 13.2	4.56	4.2	Animal meal, ground bone, corn meal, wheat bran, wheat middlings, cornstarch by-product with corn bran, ground oats.
	ANIMAL FOODS:					
4984	Albany Rendering Co., Albany, N. Y. "Albany Bone and Meat Meal for Poultry"	Albany	G 35. F 39.7	8. 11.19	—— ——	Meat and bone meal.
4983	Albany Rendering Co., Albany, N. Y. "Albany Poultry Food'	Albany	G 40. F 43.9	8. 12.24	—— ——	Prepared from cooked meat scraps. Meat scraps. Contains considerable bone.
5171	The Berg Co., Philadelphia, Pa. "3 Medal Poultry Meat"	Warwick	G 50. F 44.7	13. 11.67	3. ——	Meat and bone meal.
4769	The Bowker Fertilizer Co., New York, N. Y. "Bowker's Animal Meal for Fowls and Chicks"	Albany	G 40. F 43.6	5. 9.05	15. ——	Animal meal.
4805	The Bowker Fertilizer Co., New York, N. Y. "Bowker's Animal Meal for Fowls and Chicks"	Buffalo	G 40. F 39.8	5. 9.97	15. ——	Animal meal.

4808	H. F. Brehm, Waterloo, N. Y. "Brehm's Beef Scrap"	Geneva	G F	40. 37.	15. 18.57	—— ——	Meat scraps. Contains considerable bone.
5093	Burlington Rendering Co., Burlington, Vt. "Bone and Meat Meal for Poultry"	Lake Placid	G F	35. 50.8	8. 7.51	—— ——	Animal meal.
4615	Burlington Rendering Co., Burlington, Vt. "Burlington Poultry Food"	Norwood	G F	40. 42.93	8. 12.59	—— ——	Prepared from cooked meat scraps. Meat scraps. Contains considerable bone.
5041	Cyphers Incubator Co., Buffalo, N. Y. "High Protein Beef Scrap for Poultry"	Oxford	G F	45. 48.6	10. 11.43	—— ——	Meat scraps. Contains considerable bone.
4816	Darling & Co., Chicago, Ill. "Darling's Pure Ground Beef Scraps for Poultry"	Collins	G F	55. 54.5	10. 9.73	2.5 ——	Meat scraps. Contains a small amount of bone.
5206	Darling & Co., Chicago, Ill. "Darling's High Protein Meat Scraps for Poultry"	Hornell	G F	55. 56.2	5. 11.82	3. ——	Meat and bone scrap.
5402	The Economy Meat Food Co., Buffalo, N. Y. "Economy Beef Scrap"	Ballston Spa	G F	60. 58.4	8. 11.41	—— ——	Meat and bone scrap.
4732	George M. Finn, Syracuse, N. Y. "Ground Beef and Bone Scrap Chicken Feed"	Syracuse	G F	35. 43.	15. 22.79	—— ——	Meat scrap. Contains considerable bone.
5062	George M. Finn, Syracuse, N. Y. "Ground Beef and Bone Scrap Chicken Feed"	Camden	G F	35. 43.	15. 21.96	—— ——	Meat scraps. Contains considerable bone.

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ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
			Per ct.	*Per ct.*	*Per ct.*	
	ANIMAL FOODS (*continued*)					
5060	The Flavell Co., Asbury Park, N. J. " Vim Pure Beef Cracklings "	Rome	G* 50. F* 52.1	15. 12.43	— —	Meat scraps. Contains considerable bone.
3854	The L. T. Frisbie Co., New Haven, Conn. " Frisbie's Poultry Food "	Brooklyn	G 40. F 40.3	8. 10.84	— —	Prepared from cooked meat scraps. Meat and bone scrap.
5411	The L. T. Frisbie Co., New Haven, Conn. " Frisbie's Poultry Food "	Catskill	G 40. F 42.6	8. 11.24	— —	Prepared from cooked meat scraps. Meat and bone scrap.
5123	Globe Elevator Co., Buffalo, N. Y. " Blue Ribbon Beef Scrap for Poultry "	Bolivar	G 50. F 53.7	6. 8.53	— —	Meat and bone scrap.
5042	Geo. L. Harding, Binghamton, N. Y. " Harding's Uncle Sam Beef Scraps "	Binghamton	G 40. F 45.9	15. 11.96	Trace —	Meat scraps. Contains considerable bone.
5090	Geo. L. Harding, Binghamton, N. Y. " Harding's Uncle Sam Beef Scraps "	Waterville	G 40. F 42.6	15. 13.14	Trace —	Meat scraps. Contains considerable bone.
4917	Lowell Fertilizer Co., Boston, Mass. " Lowell Poultry Feed "	Shortsville	G 40. F 41.7	8. 12.23	— —	Prepared from cooked meat scraps. Meat scraps. Contains considerable bone.
5011	Lowell Fertilizer Co., Boston, Mass. " Lowell Poultry Food "	Oneonta	G 40. F 41.3	8. 14.47	— —	Prepared from cooked meat scraps. Meat scraps. Contains considerable bone.

4777	Lowell Fertilizer Co., Boston, Mass. "Swift's Lowell Poultry Food"	Troy	G F	40. 40.6	8. 10.58	— —	Prepared from cooked meat scraps. Meat scraps. Contains considerable bone.
5137	Reading Bone Fertilizer Co., Reading, Pa. "Reading Poultry Meat"	Tonawanda	G F	50. 38.1	16. 23.29	3. —	 Meat and bone scrap.
5188	D. W. Romaine, Jersey City, N. J. "D. W. Romaine's Evaporated Boiled Beef and Bone for Poultry"	Nanuet	G F	50. 50.5	17.85 13.59	1.8 —	Absolutely pure and containing nothing but fresh meat and sheep's heads boiled, dried and ground into meal. Animal meal.
5022	H. M. Stanton, Schenectady, N. Y. "Ground Beef Scraps"	Unadilla	G F	40. 38.1	15. 23.81	— —	 Meat scraps. Contains considerable bone.
3859	Stumpp & Walter Co., New York, N. Y. "Quality Kind Beef Scraps"	New York	G F	50. 48.3	10. 10.67	— —	 Meat and bone scrap.
4554	Swift & Co., Newark, N. J. "Swift's Beef Scrap Poultry Food"	West Nyack	G F	55. 46.6	10. 12.92	— —	 Meat and bone scrap.
4830	Swift & Co., Chicago, Ill. "Swift's Special Meat Scraps"	Jamestown	G F	50. 57.9	8. 12.31	— —	 Meat scraps. Contains considerable bone.
4960	Swift's Lowell Fertilizer Co., Boston, Mass. "Swift's Lowell Bone and Meat Meal for Poultry"	Gloversville	G F	35. 36.4	8. 8.48	— —	 Animal meal.
4744	Syracuse Rendering Co., Syracuse, N. Y. "Syracuse Bone and Meat Meal for Poultry"	Syracuse	G F	35. 45.6	8. 12.3	— —	 Animal meal.

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ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
			Per ct.	*Per ct.*	*Per ct.*	
	ANIMAL FOODS (*continued*)					
4835	Syracuse Rendering Co., Syracuse, N. Y. "Syracuse Bone Meal for Cattle and Poultry"	Jamestown	G* 20. F* 24.	5. 8.73	—— ——	Bone meal.
4804	Syracuse Rendering Co., Syracuse, N. Y. "Syracuse Cooked Meat Scraps for Poultry"	Buffalo	G 40. F 40.3	8. 10.49	—— ——	Meat scraps. Contains considerable bone.
4634	Syracuse Rendering Co., Syracuse, N. Y. "Syracuse Poultry Food"	Mexico	G 40. F 43.13	8. 15.85	—— ——	Prepared from cooked meat scraps. Meat scraps. Contains considerable bone.
4743	Syracuse Rendering Co., Syracuse, N. Y. "Syracuse Poultry Food"	Syracuse	G 40. F 46.7	8. 12.51	—— ——	Prepared from cooked meat scraps. Meat scraps. Contains a medium amount of bone.
5107	Syracuse Rendering Co., Syracuse, N. Y. "Syracuse Poultry Food"	Franklinville	G 40. F 41.3	8. 11.34	—— ——	Prepared from cooked meat scraps. Meat and bone scraps.
3872	The Van Iderstine Co., Long Island City, N. Y. "Darling's Blood Meal for Poultry"	L. I. City	G 80. F 81.5	—— .54	—— ——	Blood meal.
3864	The Van Iderstine Co., Long Island City, N. Y. "Darling's Digester Tankage for Hogs"	L. I. City	G 60. F 60.3	—— 6.19	—— ——	Meat and blood meal.

3866	The Van Iderstine Co., Long Island City, N. Y. "Darling's Digester Tankage for Hogs"	L. I. City	G F	40. 41.9	— 8.94	— —	Meat, bone and blood meal.
5030	The Van Iderstine Co., Long Island City, N. Y. "Darling's High Protein Meat Scraps for Poultry"	Delhi	G F	55. 58.1	10. 9.43	3. —	Meat scraps. Contains medium amount of bone.
5313	The Van Iderstine Co., Long Island City, N. Y. "Darling's High Protein Meat Scraps for Poultry"	Cuba	G F	55. 56.7	10. 7.92	3. —	Meat and bone scrap.
3865	The Van Iderstine Co., Long Island City, N. Y. "Darling's Pure Ground Meat Meal for Poultry"	L. I. City	G F	45. 46.4	8. 9.	3. —	Meat and bone meal.
3871	The Van Iderstine Co., Long Island City, N. Y. "Darling's Pure Ground Meat Scraps for Poultry"	L. I. City	G F	45. 45.8	8. 11.42	3. —	Meat and bone scrap.
5029	The Van Iderstine Co., Long Island City, N. Y. "Darling's Pure Ground Meat Scraps for Poultry"	Delhi	G F	45. 45.04	8. 12.01	3. —	Meat scraps contains medium amount of bone.
5057	The Van Iderstine Co., Long Island City, N. Y. "Darling's Pure Ground Meat Scraps for Poultry"	Clinton	G F	45. 48.8	8. 11.43	3. —	Meat scraps. Contains medium amount of bone.
5177	The Van Iderstine Co., Long Island City, N. Y. "Darling's Pure Ground Meat Scraps for Poultry"	West Newburgh	G F	45. 43.4	8. 10.58	3. —	Meat and bone scrap.

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ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
			Per ct.	*Per ct.*	*Per ct.*	
	ANIMAL FOODS (*concluded*)					
5169	The Van Iderstine Co., Long Island City, N. Y. "Pure Ground Beef Meal for Poultry"	Chester	G* 45. F* 45.9	8. 8.85	3. ——	Animal meal.
4806	Wuichet Fertilizer Co., Dayton, O. "Beef Scrap"	Buffalo	G 50. F 58.2	10. 11.25	1. ——	Meat scrap. Contains considerable bone.

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ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.
			Per ct.	*Per ct.*	*Per ct.*
	ALFALFA MEALS:				
5344	American Alfalfa Food Co., Wichita, Kan. "Acme Alfalfa Meal"	Salamanca	G* 14. F* 17.	1.92 2.04	25. 25.7
5403	American Milling Co., Chicago, Ill. "Amco Alfalfa Meal"	Ravena	G 13. F 12.2	2. 1.37	30. 34.92
5050	The Colorado Alfalfa Products Co., Lamar, Colo. "Alfalfa Meal"	Fayetteville	G 12. F 15.1	1. 1.79	35. 27.78
5092	The Colorado Alfalfa Products Co., Kansas City, Mo. "'Algren' Alfalfa Meal"	Saranac Lake	G 12. F 14.9	1. 2.15	35. 25.77
5412	The Colorado Alfalfa Products Co., Lamar, Colo. "'Algren' Alfalfa Meal"	Catskill	G 12. F 15.1	1. 2.43	35. 24.65
5192	Colorado Alfalfa Milling Co., Boulder, Colo. "Colorado First-Grade Alfalfa Meal"	Central Valley	G 13. F 13.5	2. 1.57	25. 31.61
5231	Colorado Alfalfa Milling Co., Boulder, Colo. "Colorado First-Grade Alfalfa Meal"	Binghamton	G 13. F 12.8	2. 1.69	25. 32.18
5330	Cyphers Incubator Co., Buffalo, N. Y. "Mealed Alfalfa"	Buffalo	G 12. F 19.3	1. 2.86	30. 15.96
4619	The Albert Dickinson Co., Chicago, Ill. "Alfalfa Meal"	Ogdensburg	G 12. F 13.47	1. 1.9	35. 29.46
4913	Harvey Seed Co., Buffalo, N. Y. "Cut Alfalfa for Poultry"	Geneseo	G —— F 13.4	—— 1.4	—— 32.71
5152	The C. Hoffman & Son Milling Co., Enterprise, Kan. "Enterprise Mills Alfalfa Meal"	Middletown	G —— F 15.7	—— 2.53	—— 26.71
3879	Kornfalfa Feed Milling Co., Kansas City, Mo. "Pioneer Alfalfa Meal"	Valley Stream	G 12. F 14.9	1.5 3.11	35. 26.68

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ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.
			Per ct.	*Per ct.*	*Per ct.*
	ALFALFA MEALS (*concluded*)				
4895	Kornfalfa Feed Milling Co., Kansas City, Mo. "Pioneer Alfalfa Meal"	Rochester	G* 12. F* 16.3	1.5 2.77	35. 22.67
5180	Kornfalfa Feed Milling Co., Kansas City, Mo. "Pioneer Alfalfa Meal"	Fishkill Landing	G 12. F 12.	1.5 1.34	35. 34.92
5238	National Feed Co., St. Louis, Mo. "Pure Alfalfa Meal"	Deposit	G 14. F 14.8	1.25 2.15	33. 29.09
5310	Omaha Alfalfa Milling Co., Omaha, Neb. "Alfalfa Meal"	Cuba	G 12. F 16.3	1. 1.82	25. 25.23
4845	M. C. Peters Mill Co., Omaha, Neb. "Alfalfa Meal (Lucern)"	Jamestown	G 12. F 14.6	.50 3.	33. 26.93
5306	M. C. Peters Mill Co., Omaha, Neb. "Lucern Pure Ground Alfalfa"	Dunkirk	G 11. F 15.6	1. 1.91	33. 26.73
5118	Russell Grain Co., Kansas City, Mo. "Square Deal Alfalfa Meal"	Olean	G 12. F 18.1	2. 2.36	25. 22.34
5308	Valley Center Alfalfa Milling Co., Valley Center, Kan. "No. 1 Alfalfa Meal"	Buffalo	G 14.39 F 14.8	1.97 1.92	32.9 27.66
3862	The Van Iderstine Co., Long Island City, N. Y. "Darling's Alfalfa Meal for Poultry"	L. I. City	G 14. F 15.6	1. 1.76	25. 29.15
5174	The Otto Weiss Alfalfa Stock Food Co., Wichita, Kan. "Pure Dustless Alfalfa Meal"	Newburgh	G 14. F 16.1	1.5 1.83	30. 24.36
4961	D. B. Abrams & Co., Gloversville, N. Y. "Alfalfa Meal"	Gloversville	G —— F 14.9	—— 1.93	—— 27.27
5068	Hyde Milling Co., Malone, N. Y. "Alfalfa"	Malone	G —— F 15.3	—— 1.88	—— 28.39

* These letters indicate, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.		Crude protein.	Crude fat.	Crude fiber.	Ingredients.
				Per ct.	Per ct.	Per ct.	
	BEET SUGAR RESIDUES:						
4721	The Larrowe Milling Co., Detroit, Mich.	Binghamton	G*	8.	.50	20.	Composed only of residue of sugar beets dried after extraction of sugar.
	"Dried Beet Pulp"		F*	8.5	1.	16.65	Dried beet pulp.
4828	The Larrowe Milling Co., Detroit, Mich.	Akron	G	8.	.50	20.	Composed only of residue of sugar beets dried after extraction of sugar.
	"Dried Beet Pulp"		F	8.6	.92	18.8	Dried beet pulp.
5458	Charles Pope, Riverdale, Ill.	Springville	G	8.	.50	20.	Composed only of residue of sugar beets.
	"Dried Beet Pulp"		F	7.9	1.07	19.72	Dried beet pulp.
	MISCELLANEOUS FEEDS:						
4791	Acme-Evans Co., Indianapolis, Ind.	Central Bridge	G	16.50	4.	9.	Wheat bran, wheat middlings, ground wheat screenings, mill run.
	"Acme Feed"		F	16.7	4.68	7.53	Wheat bran, wheat middlings.
4833	American Hominy Co., Indianapolis, Ind.	Jamestown	G	17.	5.	7.	
	"Homcoline Feed"		F	20.2	8.35	5.28	Corn oil meal.
5158	American Hominy Co., Indianapolis, Ind.	New Hampton	G	7.	4.	13.	
	"Maizeline Feed"		F	10.2	7.48	6.27	Corn bran.
4975	Beechnut Packing Co., Canajoharie, N. Y.	Canajoharie	G	15.87	36.65	10.9	
	"Peanut Chaff"		F	21.7	34.71	8.26	Peanut bran.
4974	Beechnut Packing Co., Canajoharie, N. Y.	Canajoharie	G	28.87	46.4	2.4	
	"Peanut Hearts"		F	27.4	46.4	2.35	Peanut meal.

* These letters indicate, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name	Where taken.		Crude protein.	Crude fat.	Crude fiber.	Ingredients.
				Per ct.	*Per ct.*	*Per ct.*	
	MISCELLANEOUS FEEDS (*continued*)						
4915	Big Diamond Mills Co., Minneapolis, Minn. "Big Diamond Bran"	Arcade	G*	12.	4.5	11.	Wheat bran and screenings.
			F*	15.4	5.36	11.14	
4918	The Birkett Mills, Penn Yan, N. Y. "B. W. Feed"	Canandaigua	G	——	——	——	Buckwheat hulls, buckwheat middlings.
			F	12.6	3.07	29.84	
4910	Buffalo Cereal Co., Buffalo, N. Y. "Yellow B Corn Meal"	South Alabama	G	——	——	——	Corn feed meal.
			F	9.5	4.97	4.29	
5095	Cape Vincent Seed Co., Cape Vincent, N. Y. "H. U. Pea Meal"	Cape Vincent	G	19.21	1.72	21.56	Pea meal.
			F	19.2	1.52	21.5	
5553	Cataract City Milling Co., Niagara Falls, N. Y. "Standard Middlings"	Albany	G	15.57	5.45	——	Wheat middlings.
			F	16.9	5.24	6.93	
4860	The Cleveland Seed Co., Avon, N. Y. "Pea Meal"	Avon	G	17.	1.3	24.	Pea meal.
			F	15.3	1.45	25.27	
5191	Deposit Milling Co., Deposit, N. Y. "Horse Feed"	Spring Valley	G	——	——	——	Ground corn and oats.
			F	10.8	3.75	3.97	
4878	The Albert Dickinson Co., Chicago, Ill. "Corn Feed Meal"	Pittsford	G	——	——	——	Corn feed meal.
			F	7.	2.22	.82	

'876	Fenton & Hawkins, Canandaigua, N. Y. " Wheat Middlings "	Canandaigua	G F	— 17.	— 5.15	— 4.06	Wheat middlings.
5203	The Gardner Mills, Hastings, Minn. " Snow Ball Flour Middlings, Wheat Middlings "	Elmira	G F	15.5 18.2	4.7 5.27	— 6.45	Wheat middlings.
4728	General Flour & Feed Co., Buffalo, N. Y. " Buffalo Meal "	Syracuse	G F	7. 8.9	3. 3.48	7. 4.81	Corn and cob meal. The amount of cob used being the same as though ear corn was ground cob and all. As certified.
5113	Globe Elevator Co., Buffalo, N. Y. " Rolled Oats "	Franklinville	G F	— 11.69	— 5.	— 8.29	Ground oats.
5460	D. H. Grandin Milling Co., Jamestown, N. Y. " Corn Meal "	Jamestown	G F	— 8.4	— 3.89	— 1.83	Corn meal.
4908	Grove Products Co., Jersey City, N. J. " Ground Bread "	Goshen	G F	13. 13.8	1.5 1.66	1. .36	Composed of ground bread. As certified.
4956	Hayes & Co., Altamont, N. Y. " Buckwheat Feed "	Altamont	G F	— 27.31	— 7.61	— 9.36	Buckwheat bran and middlings only. Buckwheat middlings, buckwheat hulls, small amount of kaffir corn.
4865	Hennepin Mill Co., Minneapolis, Minn. " Ben Hur Coarse Bran "	Geneva	G F	14.5 15.8	4. 6.02	11. 10.82	Pure hard wheat. Wheat bran and screenings.
4873	J. A. Hinds & Co., Rochester, N. Y. " Bran "	Geneva	G F	14.5 16.3	4.2 5.22	11.8 9.03	Wheat bran.

* These letters indicate, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
			Per ct.	*Per ct.*	*Per ct.*	
	MISCELLANEOUS FEEDS (*continued*)					
4915	Big Diamond Mills Co., Minneapolis, Minn. "Big Diamond Bran"	Arcade	G* 12. F* 15.4	4.5 5.36	11. 11.14	Wheat bran and screenings.
4918	The Birkett Mills, Penn Yan, N. Y. "B. W. Feed"	Canandaigua	G — F 12.6	— 3.07	— 29.84	Buckwheat hulls, buckwheat middlings.
4910	Buffalo Cereal Co., Buffalo, N. Y. "Yellow B Corn Meal"	South Alabama	G — F 9.5	— 4.97	— 4.29	Corn feed meal.
5095	Cape Vincent Seed Co., Cape Vincent, N. Y. "H. U. Pea Meal"	Cape Vincent	G 19.21 F 19.2	1.72 1.52	21.56 21.5	Pea meal.
5553	Cataract City Milling Co., Niagara Falls, N. Y. "Standard Middlings"	Albany	G 15.57 F 16.9	5.45 5.24	— 6.93	Wheat middlings.
4860	The Cleveland Seed Co., Avon, N. Y. "Pea Meal"	Avon	G 17. F 15.3	1.3 1.45	24. 25.27	Pea meal.
5191	Deposit Milling Co., Deposit, N. Y. "Horse Feed"	Spring Valley	G — F 10.8	— 3.75	— 3.97	Ground corn and oats.
4878	The Albert Dickinson Co., Chicago, Ill. "Corn Feed Meal"	Pittsford	G — F 7.	— 2.22	— .82	Corn feed meal.

'876	Fenton & Hawkins, Canandaigua, N. Y. "Wheat Middlings"	Canandaigua	G	——	——	——	
			F	17.	5.15	4.06	Wheat middlings.
5203	The Gardner Mills, Hastings, Minn. "Snow Ball Flour Middlings, Wheat Middlings"	Elmira	G	15.5	4.7	——	
			F	18.2	5.27	6.45	Wheat middlings.
4728	General Flour & Feed Co., Buffalo, N. Y. "Buffalo Meal"	Syracuse	G	7.	3.	7.	Corn and cob meal. The amount of cob used being the same as though ear corn was ground cob and all.
			F	8.9	3.48	4.81	As certified.
5113	Globe Elevator Co., Buffalo, N. Y. "Rolled Oats"	Franklinville	G	——	——	——	
			F	11.69	5.	8.29	Ground oats.
5460	D. H. Grandin Milling Co., Jamestown, N. Y. "Corn Meal"	Jamestown	G	——	——	——	
			F	8.4	3.89	1.83	Corn meal.
4998	Grove Products Co., Jersey City, N. J. "Ground Bread"	Goshen	G	13.	1.5	1.	Composed of ground bread.
			F	13.8	1.66	.36	As certified.
4956	Hayes & Co., Altamont, N. Y. "Buckwheat Feed"	Altamont	G	——	——	——	Buckwheat bran and middlings only.
			F	27.31	7.61	9.36	Buckwheat middlings, buckwheat hulls, small amount of kaffir corn.
4865	Hennepin Mill Co., Minneapolis, Minn. "Ben Hur Coarse Bran"	Geneva	G	14.5	4.	11.	Pure hard wheat.
			F	15.8	6.02	10.82	Wheat bran and screenings.
4873	J. A. Hinds & Co., Rochester, N. Y. "Bran"	Geneva	G	14.5	4.2	11.8	
			F	16.3	5.22	9.03	Wheat bran.

* These letters indicate, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.		Crude protein.	Crude fat.	Crude fiber.	Ingredients.
				Per ct.	*Per ct.*	*Per ct.*	
	MISCELLANEOUS FEEDS (*continued*)						
5226	Twing R. Hitt, Killawog, N. Y. "Buckwheat Feed"	Killawog	G*	——	——	——	Buckwheat hulls, buckwheat middlings and hominy.
			F*	11.9	3.61	17.64	Buckwheat middlings, buckwheat hulls.
5456	The H-O Co., Buffalo, N. Y. "Force Screenings"	Buffalo	G	11.	3.	9.	Wheat, salt.
			F	14.	5.26	4.45	As certified.
5223	Hunter-Robinson-Wenz Milling Co., St. Louis, Mo. "Dreadnought Winter Bran"	Marathon	G	14.5	4.	9.5	Pure wheat product.
			F	15.	4.26	7.86	Wheat bran containing a fair amount of whole wheat.
4680	Husted Milling Co., Buffalo, N. Y. "B Meal"	Indian Falls	G	——	——	——	
			F	9.4	4.86	2.16	Corn meal.
5338	Husted Milling Co., Buffalo, N. Y. "Corn Bran"	Buffalo	G	8.	4.	12.	Made from corn.
			F	10.9	5.11	9.57	Corn bran.
4890	Husted Milling Co., Buffalo, N. Y. "Yellow Corn Meal B"	Wolcott	G	——	——	——	
			F	9.7	5.48	2.79	Corn feed meal.
5233	Kemper Mill & Elevator Co., Kansas City, Mo. "Anchor Bran"	Solsville	G	14.5	4.	9.5	Made from pure wheat.
			F	16.3	4.68	9.27	Wheat bran and screenings.
5162	Chas. A. Krause Milling Co., Milwaukee, Wis. "Badger Cream Flakes"	Johnson	G	9.	7.	9.	Made from pure white corn.
			F	9.6	6.36	7.91	Corn bran.

5241	Listman Mill Co., La Crosse, Wis. "Elmco Fancy Wheat Bran"	Spencer	G	15.68	4.20	9.71	
			F	17.5	5.66	8.15	Wheat bran.
5242	Marshall Milling Co., Marshall, Minn. "Bran"	Ithaca	G	15.	4.8	11.8	
			F	16.2	5.5	9.48	Wheat bran.
4705	Geo. Q. Moon & Co., Binghamton, N. Y. "Fresh Ground Home Made Middlings"	Binghamton	G	——	——	——	
			F	15.	3.95	4.38	Wheat bran, wheat middlings, wheat screenings.
5216	Geo. Q. Moon & Co., Binghamton, N. Y. "Mixed Feed"	Ouaquaga	G	——	——	——	
			F	16.5	5.09	8.02	Wheat bran, wheat middlings, and more or less shrunken wheat.
4882	Moseley & Motley Milling Co., Rochester, N. Y. "Choice Wheat Bran"	Rochester	G	——	——	——	
			F	16.	5.45	8.49	Wheat bran.
5551	National Milling Co., Toledo, O. "National Feed"	Glens Falls	G	16.	3.75	8.5	Said to be bran and middlings.
			F	17.	4.87	7.79	Wheat bran, wheat middlings.
4704	Niagara Falls Milling Co., Niagara Falls, N. Y. "S Wheat Middlings"	Binghamton	G	——	——	——	
			F	18.06	6.08	6.96	Wheat bran, wheat middlings, and in a filthy condition due to the presence of worms.
4875	Roy Nichols, Holcomb, N. Y. "Wheat Bran"	Shortsville	G	——	——	——	
			F	16.5	5.42	8.28	Wheat bran and screenings.
4884	The North Western Consolidated Milling Co., Minneapolis, Minn. "Pure Wheat Bran"	Lyons	G	14.5	4.	11.	
			F	15.8	5.34	10.29	Wheat bran containing a small amount of screenings.
5246	The Northwestern Consolidated Milling Co., Minneapolis, Minn. "Pure Wheat Middlings"	Greene	G	15.	4.5	10.	
			F	18.2	5.46	7.19	Wheat middlings. Contains salt.

* These letters indicate, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*continued*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.		Crude protein.	Crude fat.	Crude fiber.	Ingredients.
				Per ct.	Per ct.	Per ct.	
	MISCELLANEOUS FEEDS (*continued*)						
5254	North-West Mills Co., Winona, Minn. "Fancy Empire Heavy Mixed Feed"	Bainbridge	G*	15.	3.	10.	
			F*	15.4	3.05	6.75	Wheat bran, wheat middlings, ground screenings.
4855	A. Nowak & Son, Buffalo, N. Y. "Stand. Meal"	Moscow	G	——	——	——	
			F	9.4	4.93	2.23	Corn meal.
3867	Purabla Oil Co., Blue Point, L. I., "Purabla Oil Meal"	Blue Point	G	30.	15.	5.	
			F	41.1	15.76	4.72	Sesame oil meal.
1202	Phelps & Sibley, Cuba, N. Y. "Wheat Bran"	Fowlerville	G	——	——	——	
			F	14.9	4.22	8.76	Wheat bran.
4698	The Quaker Oats Co., Chicago, Ill. "Buckeye Mixed Feed"	Gainesville	G	13.	4.	8.	Wheat bran, wheat middlings and ground wheat.
			F	17.3	5.23	8.07	As certified.
5023	The Quaker Oats Co., Chicago, Ill. "Buckeye Mixed Feed"	Unadilla	G	13.	4.	8.	Wheat bran, wheat middlings and ground wheat.
			F	16.4	5.12	8.79	As certified.
5151	The Quaker Oats Co., Chicago, Ill. "Buckeye Mixed Feed"	Middletown	G	13.	4.	8.	Wheat bran, wheat middlings and ground wheat.
			F	16.8	5.29	8.39	As certified.
4810	The Quaker Oats Co., Chicago, Ill. "Ground Puffed Rice"	Eden Center	G	7.5	.5	.5	Made from ground puffed rice.
			F	8.53	.55	.45	Ground, puffed rice.

4809	The Quaker Oats Co., Chicago, Ill. "Ground Puffed Wheat"	Eden Center	G F	15. 15.19	2.5 2.89	1.5 2.35	Made from ground puffed wheat. Ground, puffed wheat.
4874	Red Wing Milling Co., Red Wing, Minn. "Bixota Middlings"	Shortsville	G F	17. 18.5	4. 5.98	9.7 5.72	Wheat middlings.
5341	James O. Rignel, Lockport, N. Y. "Pure Ground Oats"	Lockport	G F	—— 13.	—— 5.1	—— 9.37	Ground oats.
4866	R. H. Robinson, Geneva, N. Y. "Wheat Middlings"	Geneva	G F	—— 16.2	—— 5.02	—— 4.87	Wheat middlings.
4867	R. H. Robinson, Geneva, N. Y. "Wheat Bran"	Geneva	G F	—— 16.2	—— 4.56	—— 7.83	Wheat bran.
4893	L. A. Rogers & Co., Rochester, N. Y. "Wheat Bran"	Rochester	G F	—— 14.9	—— 4.75	—— 8.43	Wheat bran.
4735	Ryan Bros., Jamesville, N. Y. "Barley Feed"	Syracuse	G F	13. 15.7	3.5 3.9	7.8 6.87	Barley feed. Contains some wheat and oat products and a small amount of weed seeds.
5138	The Shredded Wheat Co., Niagara Falls, N. Y. "Shredded Wheat Waste"	Tonawanda	G F	10. 12.9	1.5 2.24	2. 2.15	Shredded wheat waste.
5237	Allen V. Smith, Marcellus Falls, N. Y. "Barley Feed"	Marcellus Falls	G F	13. 14.	3. 4.25	12. 7.99	Barley, barley middlings, ground oats.
4870	The Southwestern Milling Co., Kansas City, Mo. "Bran"	Geneva	G F	15.25 16.3	4. 4.52	9.5 8.9	Wheat bran.

* These letters indicate, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF FEEDING STUFFS (*concluded*).

Number.	Name and address of manufacturer or jobber and brand or trade name.	Where taken.	Crude protein.	Crude fat.	Crude fiber.	Ingredients.
			Per ct.	*Per ct.*	*Per ct.*	
	MISCELLANEOUS FEEDS (*concluded*)					
5210	The Southwestern Milling Co., Kansas City, Mo. "Red Turkey Bran"	Chemung	G* 15.25 F* 15.5	4. 4.67	9.5 9.74	Wheat bran.
5224	F. W. Stock & Sons, Hillsdale, Mich. "Bran from Pure Wheat"	Marathon	G 15.5 F 15.7	3. 4.55	9.5 7.56	Wheat bran containing a fair amount of whole wheat.
4871	Thompson Milling Co., Lockport, N. Y. "Angelus Middlings"	Geneva	G 17.5 F 17.5	5. 5.03	10. 7.79	Wheat middlings and screenings.
4999	Thompson & Mould, Goshen, N. Y. "Corn Bran"	Goshen	G —— F 12.8	—— 9.7	—— 5.97	Corn bran.
4892	Thornton & Chester Milling Co., Buffalo, N. Y. "Coarse Midds"	Sodus	G 14. F 16.6	3. 5.69	—— 7.83	Pure wheat product. Wheat middlings.
5253	The Toledo Elevator Co., Indianapolis, Ind. "Cob Meal"	Waverly	G 1.95 F 2.2	.4 .72	35. 29.11	Ground corn cob.
4869	Washburn-Crosby Mills, Buffalo, N. Y. "Pure Hard Wheat Coarse Bran"	Geneva	G 14.5 F 15.	4. 4.88	11. 9.99	Wheat bran.
4885	Washburn-Crosby Co., Minneapolis, Minn. "Washburn-Crosby Co's Pure Hard Wheat Coarse Bran"	Savannah	G 14.5 F 15.6	4. 6.3	11. 10.43	Wheat bran and screenings.

4898	Washburn-Crosby Co., Minneapolis, Minn. "Washburn-Crosby Co's Pure Hard Wheat Coarse Bran"	Corfu	G F	14.5 15.1	4. 5.8	11. 10.64	Wheat bran and screenings.
4904	Washburn-Crosby Co., Minneapolis, Minn. "Washburn-Crosby Co's Pure Hard Wheat Coarse Bran"	Castile	G F	14.5 15.3	4. 5.8	11. 10.36	Wheat bran and screenings.
4905	Washburn-Crosby Co., Minneapolis, Minn. "Washburn-Crosby Co's Pure Hard Wheat Coarse Bran"	Perry	G F	14.5 15.3	4. 5.85	11. 9.98	Wheat bran and screenings.
5327	Washburn-Crosby Co., Minneapolis, Minn. "Washburn-Crosby Co's Pure Hard Wheat Coarse Bran"	No. Collins	G F	14.5 15.4	4. 6.05	11. 10.07	Wheat bran and screenings.
3890	Washburn Mills, Minneapolis, Minn. "Washburn-Crosby Co's Pure Hard Wheat Flour Middlings"	Callicoon	G F	17. 17.4	5. 5.36	6. 5.2	Wheat middlings.
3891	Washburn Mills, Minneapolis, Minn. "Washburn-Crosby Co's Pure Hard Wheat Standard Middlings"	Callicoon	G F	15. 17.8	4. 5.93	8. 5.8	Wheat middlings.
4891	Washburn Mills, Minneapolis, Minn. "Washburn-Crosby Co's Pure Hard Wheat Standard Middlings"	North Rose	G F	16. 19.4	4. 5.73	8. 7.05	Wheat middlings.
5225	The Williams Bros. Co., Kent, O. "Fancy Winter Wheat Middlings"	Truxton	G F	— 15.2	— 4.54	— 6.03	Wheat middlings.

* These letters indicate, respectively, Guaranteed and Found.

COMMENTS ON RESULTS OF INSPECTION 1912-13.

E. L. BAKER.

This bulletin contains the results of analyses and microscopical examinations of 737 samples of concentrated commercial feeding stuffs, representing 479 brands which have been collected by the agents of the Commissioner of Agriculture during the season of 1912-13.

Only 9.8 per ct. of these brands are appreciably below guarantee so far as protein, fat and fibre are concerned, which is a very satisfactory showing and a marked improvement over other years; on the other hand, in nearly 25 per ct. of the brands examined, the ingredients vary sufficiently from those guaranteed to constitute misbranding.

Some discrepancies are plainly cases of adulteration, while others appear to be due to ignorance on the part of the manufacturers concerning the proper names to use for certain feeding materials.

A list of feed definitions, adopted by the Association of Feed Control Officials was published in the last feeding stuffs bulletin,* clearly describing the terms to be used, and circulars containing

TABLE I.—NUMBER AND KINDS OF FEEDING STUFFS ANALYSED, 1912-13.

CLASSIFICATION.	Number of brands sampled.	Number of samples analysed.	Number of brands appreciably below guarantee.
Cottonseed meals	24	34	4
Linseed meals	12	21	0
Malt sprouts	21	25	5
Dried distillers' grains	22	35	1
Dried brewers' grains	14	19	1
Corn starch by-product with corn bran	12	23	2
Hominy feeds	22	28	0
Compounded feeds	129	224	9
Molasses feeds (compounded)	49	97	11
Cottonseed feeds (compounded)	7	11	3
Poultry feed (compounded)	44	71	4
Animal feeds	35	48	4
Alfalfa meals	20	24	3
Beet sugar residues	2	3	0
Unclassified	66	74	0
Totals	479	737	47

*N. Y. Agri. Exp. Station, Bul. No. 351.

these definitions were forwarded to feed manufacturers during the past year from the State Department of Agriculture. It is hoped that in future manufacturers will be able to avoid such inaccuracy in the use of terms as has marked many guarantees of ingredients in samples analyzed during the past season.

In Table I are shown the number of brands sampled and analyzed during the season of 1912–13, and the number of brands falling considerably below guarantee.

CORN STARCH BY-PRODUCT WITH (OR WITHOUT) CORN BRAN.

The commodities formerly known as " Gluten Feeds " or " Gluten Meals " have been treated in this bulletin under the names " Corn Starch By-product with (or without) Corn Bran," these names having been adopted by the Association of Feed Control Officials. The definitions of these terms are given on page 349.

Investigators of the vegetable proteins and authorities on this subject agree that the so-called " gluten feeds " and " gluten meals " contain little, if any, true gluten. It was largely owing to such a condition that the Association found it undesirable to attempt to define a term which was not truly descriptive of the product to which it was applied and, further, which had little if any relation thereto. The names " Corn Starch By-product with (or without) Corn Bran," were accordingly adopted for these misnomers.

In this bulletin wherever these terms are used, they should be clearly understood as covering the products formerly known as " Gluten Feeds " or " Gluten Meals."

SCREENINGS IN WHEAT OFFALS.

Complaints have been received at this Station that certain samples of wheat bran and wheat middlings have been found to be adulterated with screenings. Several samples of these materials were obtained by the agents of the Department of Agriculture and forwarded to the laboratories of the Experiment Station for examination. For the most part these products were found to be pure and unadulterated or at worst, to contain only traces of foreign matter, but the practice of utilizing screenings from wheat by adding them to the bran has become too prevalent to be disregarded. In some cases the quantities of screenings found amount to from 40 to 120 pounds to the ton. Moreover, many whole seeds are often present and a large percentage of them are unaffected by the digestive processes of the animal. Many of them will germinate upon reaching the soil, thereby scattering obnoxious weeds about the farm.

In the following table are shown the approximate percentage of screenings found in a few samples of wheat bran.

TABLE II.— APPROXIMATE PERCENTAGE OF SCREENINGS IN WHEAT BRAN.

Sample No.	MANUFACTURER'S NAME AND ADDRESS.	Brand name.	Amount of screenings found.	Condition of seeds.
			Per ct.	
4865	Hennepin Milling Co., Minneapolis, Minn.	Ben Hur, coarse bran.	Over 5.	Finely ground.
4875	Roy Nichols, Holcomb, N. Y.	Wheat bran.	" 4.4	Whole seeds.
4898	Washburn Crosby Co., Minneapolis, Minn.	Pure hard wheat, coarse bran.	" 5.	Finely ground.
4904	Washburn Crosby Co., Minneapolis, Minn.	"	" 6.5	" "
4905	Washburn Crosby Co., Minneapolis, Minn.	"	" 2.	" "
5327	Washburn Crosby Co., Minneapolis, Minn.	"	" 4.	" "
5223	Hunter-Robinson-Wenz Milling Co., St. Louis, Mo.	Dreadnought, winter bran.	" 2.	Mostly whole seeds.

BUCKWHEAT BY-PRODUCTS.

Buckwheat shorts or buckwheat middlings are defined as those portions of the buckwheat grains immediately inside of the hulls, after separation from the flour.

These by-products as they appear upon the markets of this State are frequently found to contain an admixture of various amounts of hulls, which greatly lower the nutritive value of the feed.

Mixtures of buckwheat middlings and buckwheat hulls, where sold as buckwheat middlings, are regarded as misbranded. They are also considered misbranded when sold under the name buckwheat feed, unless the presence of hulls is plainly stated.

The term " Buckwheat Feed " should be applied only to the entire kernel ground to a meal.

Table III gives the analysis price per ton and approximate percentage of hulls in several samples of buckwheat middlings and so-called buckwheat feeds.

The analyses given in this table show little uniformity in the composition of buckwheat by-products, the protein varying from 11.9 per ct. to 37.5 per ct.; fat 1.3 per ct. to 8.5 per ct.; fiber, 5.7 per ct. to 29.8 per ct. and the amount of hulls 5 per ct. to 66 per ct.

TABLE III.— ANALYSIS OF BUCKWHEAT MIDDLINGS AND BUCKWHEAT FEEDS AND PRICE PER TON.

Sample No.	MANUFACTURER'S NAME AND ADDRESS.	Protein.	Fat.	Fiber.	Hulls.	Sold as.	Price per ton.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*		
382	————	29.63	8.51	5.74	5.	Middlings.	$30 00
383	Bill Bros., Orleans, N. Y.	37.50	3.13	8.82	10.	"	23 00
384	A. S. Rathbun, Phelps, N. Y.	27.63	1.34	26.47	30.	"	23 00
—	J. H. Strait Milling Co., Canisteo, N. Y.	18.00	4.33	20.56	36.	"	23 00
4956	Hayes & Co., Altamont, N. Y.	27.31	7.61	9.36	23.	Feed.	25 00
4918	The Birkett Mills, Penn Yan, N. Y.	12.4	3.17	29.85	66.	"	24 00
5226	T. R. Hitt, Killawog, N. Y.	11.9	3.61	17.64	43.	"	20 00

At the same time it will be noticed that the cost of exceedingly low grade products is about the same as of much more valuable materials. Pure buckwheat middlings will run well over 30 per ct. of protein and should contain only traces of hulls, if any.

SAND.

The last two feeding stuffs bulletins* published by this Station, contained tables giving the percentages of sand and silica in certain feeding stuffs samples. It was found that, almost invariably, those samples to which screenings had been added contained sand, varying from traces to excessive amounts.

Grain when it comes from the field contains more or less foreign matter, which must be removed before it is ready for milling. This is accomplished by blowing or aspirating, and passing the grain over screens, which removes the small and imperfect grains, weed seeds, chaffy matter and other refuse. This process of screening also removes more or less sand and dirt which necessarily accompany the grain and unless this gritty material is separated from the screenings, it will appear later in feeds with which the screenings are compounded. Straight screenings have been found to contain as high as 4 per ct. to 6 per ct. of actual sand.

*N. Y. Agri. Exp. Station, Buls. 340 and 351.

During the past season all feeding stuffs containing screenings as an ingredient have been tested for sand.* The results appear in Table IV.

TABLE IV.— PERCENTAGE OF SAND FOUND IN FEEDS COMPOUNDED WITH SCREENINGS.

SAMPLE No.	Sand.	SAMPLE No.	Sand.	SAMPLE No.	Sand.
	Per ct.		*Per ct.*		*Per ct.*
3853	.39	4799	1.19	5021	1.30
3858	.32	4803	.77	5034	3.20
3861	1.24	4836	.43	5036	2.28
3880	1.23	4871	.25	5045	2.92
3881	1.09	4875	.56	5049	.53
3882	1.29	4885	.29	5065	.93
4613	.46	4887	1.96	5067	.84
4624	1.47	4898	.33	5080	1.38
4625	1.05	4900	1.64	5084	.34
4627	1.40	4902	.57	5091	.12
4629	1.24	4904	.40	5111	1.00
4635	†1.34	4905	.37	5116	1.15
4640	.88	4914	.49	5120	1.43
4644	1.83	4915	.27	5122	1.41
4646	.52	4921	.91	5124	1.44
4670	.41	4952	2.04	5126	.90
4675	1.67	4955	†2.41	5142	.92
4681	.82	4959	.63	5146	4.20
4691	1.57	4964	1.25	5147	2.36
4695	.81	4965	1.16	5156	1.13
4697	.28	4968	1.99	5157	1.79
4705	.22	4970	.60	5160	1.43
4709	1.43	4976	.45	5193	1.80
4725	2.09	4989	1.02	5196	.23
4742	.89	4990	.38	5219	.94
4754	1.47	4992	4.20	5230	.60
4755	1.58	4993	1.11	5243	2.05
4759	.49	5001	1.33	5245	1.07
4760	.61	5004	1.65	5254	.50
4764	.79	5013	1.97	5327	.41
4765	.77	5016	.80	5335	1.46
4776	.61	5017	.80	5459	1.20
4791	.13	5018	1.17		
4798	.38	5019	.98		

FEEDING STUFFS' DEFINITIONS.

The following feeding stuffs' definitions are, with the exception of a few changes, essentially those adopted by the Association of Feed Control Officials at Columbus, Ohio, in November, 1911:

*Official method, U. S. Dept. of Agri., Chem. Bul. 107.
† Malt sprouts.

Meal is the clean, sound, ground product of the entire grain, cereal or seed which it purports to represent; provided that the following materials are to be known as meals, qualified by their descriptive names, viz.:

Corn germ meal is chiefly the germ of the corn kernel from which a part of the oil has been extracted.

Linseed meal is the ground residue, after extraction of a large part of the oil, from ground flax seed.

Cotton seed meal is a product of the cotton seed only, composed principally of the kernel, with such portion of the hull as is necessary in the manufacture of oil, provided that nothing shall be recognized as cottonseed meal that does not conform to the foregoing definition, and that does not contain at least thirty-six (36) per ct. of protein.

Choice cotton seed meal must be finely ground, not necessarily bolted, perfectly sound and sweet in odor, yellow, free from excess of lint, and must contain at least forty-one (41) per ct. of protein.

Prime cottonseed meal must be finely ground, not necessarily bolted, of sweet odor, reasonably bright in color, yellow, not brown or reddish, free from excess of lint and must contain at least thirty-eight and six-tenths (38.6) per ct. of protein.

Good cottonseed meal must be finely ground, not necessarily bolted, of sweet odor, reasonably bright in color and must contain at least thirty-six (36) per ct. of protein.

Hominy meal, hominy feed or *hominy chop* is a mixture of the bran coating, the germ and a part of the starchy portion of the corn kernel.

Corn feed meal is the siftings obtained in the manufacture of cracked corn and table meal made from the whole grain.

Grits are the hard flinty portions of Indian corn without hulls and germ.

Corn bran is the outer coating of the corn kernel.

Corn starch by-product with corn bran is that portion of commercial shelled corn that remains after the separation of the larger part of the starch, and the germ by the processes employed in the manufacture of corn starch and glucose. It may or may not contain corn solubles.

Corn starch by-product without corn bran is that portion of commercial shelled corn that remains after the separation of the larger part of the starch, the germ and the bran by the processes employed in the manufacture of corn starch and glucose. It may or may not contain corn solubles.

Wheat bran is the coarse outer coatings of the wheat berry.

Wheat shorts or *standard wheat middlings* are the fine particles of the outer and inner bran separated from bran and white middlings.

Wheat mixed feed is a mixture of the products other than the flour from the milling of the wheat berry.

Red dog is a low grade wheat flour containing the finer particles of bran.

Oat groats are the kernels of the oat berry with the hulls removed.

Oat shorts are the covering of the oat grain lying immediately inside the hull. These make a fuzzy material carrying with it considerable portions of the fine floury part of the groat obtained in the milling of rolled oats.

Oat middlings are the floury portion of the groat obtained in the milling of rolled oats.

Oat clippings are the hairs, oat dust, ends of oats and light oats separated from the oat kernel by the clipping process.

Clipped oat refuse is the resultant by-product obtained in the manufacture of clipped oats. It may contain light, chaffy material broken from the ends of the hulls, empty hulls, light immature oats and dust. It must not contain an excessive amount of oat hulls.

Oat hulls are the outer chaffy coverings of the oat grain.

Rice hulls are the outer chaffy coverings of the rice grain.

Rice bran is the cuticle beneath the hull.

Rice polish is the finely powdered material obtained by polishing the kernel.

Flax plant by-product is that portion of the flax plant remaining after the separation of the seed, the bast fibre and portions of the shives; and consists of flax shives, flax pods, broken and immature flax seeds and the cortical tissue of the stem.

Buckwheat shorts or *buckwheat middlings* are those portions of the buckwheat grains immediately inside of the hulls after separation from the flour.

Blood meal is ground dried blood.

Meat scrap and *meat meal* are the ground residues from animal tissue, practically exclusive of hoof and bone. If they contain any considerable amount of bone, they must be designated *meat and bone scrap*, or *meat and bone meal*. If they bear a name descriptive of their kind, composition or origin, they must correspond thereto.

Cracklings are the residue after partially extracting the fats and oils from animal tissue. If they bear a name descriptive of their kind, composition or origin, they must correspond thereto.

Digester tankage is the residue from animal tissue practically exclusive of hoof and horn, specially prepared for feeding purposes by tanking under live steam, drying under high heat and suitable grinding. If it contains any considerable amount of bone, it must be designated digester meat and bone tankage.

Distillers' dried grains are the dried residue from cereals obtained in the manufacture of alcohol and distilled liquors.

Brewers' dried grains are the properly dried residue from cereals, mostly barley, obtained in the manufacture of beer.

Malt sprouts are the sprouts of the barley grain. If the sprouts are derived from any other malted cereal the source must be designated.

Alfalfa meal is the entire alfalfa hay ground and does not contain an admixture of ground alfalfa straw or other foreign materials.

Chop is a ground or chop feed composed of one or more different cereals. If it bears a name descriptive of the kind of cereals, it must be made exclusively of the entire grains of those cereals.

Screenings are the smaller imperfect grains, weed seeds and other foreign materials separated in cleaning the grain.

PROVISIONS OF THE AGRICULTURAL LAW RELATING TO THE SALE AND ANALYSIS OF CONCENTRATED COMMERCIAL FEEDING STUFFS.

ARTICLE VII.*

SALE AND ANALYSIS OF CONCENTRATED COMMERCIAL FEEDING STUFFS.

§ 160. **Term "concentrated commercial feeding stuffs" defined.** — The term "concentrated commercial feeding stuffs" as used in this article, shall include linseed meals, cotton seed meals, pea meals, bean meals, peanut meals, cocoanut meals, gluten meals, gluten feeds, maize feeds, starch feeds, sugar feeds, dried distillers' grains, dried brewers' grains, malt sprouts, except as hereinafter provided, hominy feeds, cerealine feeds, rice meals, dried beet refuse, oat feeds, corn and oat chops, corn and cob meal, ground beef or fish scraps, meat meals, meat and bone meals mixed, dried blood, mixed feeds, clover meals, alfalfa feeds and meals, compounded feeds, condimental stock and poultry foods, proprietary or trade-marked stock and poultry foods, and all other materials of similar nature; but shall not include hays and straws, the whole seeds nor the unmixed meals made directly from the entire grains of wheat, rye, barley, oats, corn, buckwheat and broom corn, neither shall it include wheat, rye and buckwheat brans or middlings, not mixed with other substances, but sold separately, as distinct articles of commerce, nor pure grains ground together, nor corn meal and wheat bran mixed together, when sold as such by the manufacturer at retail, nor wheat bran and middlings mixed together not mixed with any other substances and known in the trade as "mixed

Exceptions.

*Laws of 1909, Chapter 9, Article 7 (Chapter 1 of the Consolidated Laws).

feed," nor ground or cracked bone not mixed with any other substance, nor shall it include poultry foods consisting of whole or whole and cracked grains and grit mixed together when all the ingredients may be identified by the naked eye. (*As amended by chapter* 436 *of the Laws of* 1910 *and chapter* 277 *of the Laws of* 1912.)

§ 161. **Statements to be attached to packages; contents; analysis.** — No manufacturer, firm, association, corporation or person shall sell, offer or expose for sale or for distribution in this state, any concentrated commercial feeding stuffs used for feeding live stock unless such concentrated commercial feeding stuffs shall be accompanied by or shall have affixed to each and every package in a conspicuous place on the outside thereof, a plainly printed statement which shall certify as follows:

1. The net weight of the contents of the package, except in the case of malt sprouts sold in packages containing uneven weights.
2. The name, brand or trade mark.
3. The name and principal address of the manufacturer or person responsible for the placing of the commodity upon the market.
4. Its composition expressed in the following terms:
   a. The minimum per centum of crude protein.
   b. The minimum per centum of crude fat.
   c. The maximum per centum of crude fiber, provided that the per centum of crude fiber may be omitted if it does not exceed five per centum.
   d. If a compounded feed, the name of each ingredient contained therein.
   e. If artificially colored, the name of the material used for such purpose.

If any such concentrated commercial feeding stuffs be sold, offered or exposed for sale in bulk, such printed statement shall accompany every car or lot. **Bulk goods.** Any such feeding stuffs purchased in bulk and later sacked or bagged for purposes of sale shall have tags attached giving the information as provided herein before being sold, offered or exposed for sale. Whenever any feeding stuff is sold at retail in bulk or in packages belonging to the purchaser, the seller upon request of the purchaser shall furnish the said purchaser the information contained in the certified statement provided herein. **Guaranteed analysis.** That portion of the statement required by this section relating to the quality of feeding stuffs shall be known and recognized as the guaranteed analysis. (*As amended by chapter* 317 *of the Laws of* 1909 *and by chapter* 314 *of the Laws of* 1911.)

§ 162. **Statements to be filed with commissioner of agriculture; to be accompanied by sample and affidavit when requested.**—Before any manufacturer, firm, association, corporation or person shall sell, offer or expose for sale in this state any concentrated commercial

feeding stuffs, he or they shall, for each and every brand of concentrated commercial feeding stuff, file annually prior to January first of the calendar year in which such commodity is to be sold, offered or exposed for sale with the commissioner of agriculture a certified copy of the statement, with the exception of the net weight of the contents of the package, specified in section one hundred and sixty-one, said certified copy to be accompanied, when the said commissioner shall so request, by a sealed glass jar or bottle containing at least one pound of the feeding stuff to be sold or offered for sale, and the company or person furnishing said sample shall thereupon make affidavit that said sample corresponds to the feeding stuff which it represents, in the per centum of crude protein, crude fat, crude fiber, name of each ingredient contained therein, if a compounded feed, and the name of any artificial coloring material used. (*As amended by chapter* 317 *of the Laws* of 1909 *and by chapter* 314 *of the Laws* of 1911.)

§ 163. **License fee.**— Every manufacturer, importer, agent or seller of any concentrated commercial feeding stuffs, shall pay annually prior to January first of the calendar year in which such commodity is to be sold, offered or exposed for sale to the treasurer of the state of New York a license fee of twenty-five dollars for each and every brand to be sold or offered or exposed for sale. Whenever a manufacturer, importer, agent or seller of any concentrated commercial feeding stuffs desires at any time to sell such material and has not complied with the requirements of the statute he shall before selling, offering or exposing the same for sale, comply with the requirements as herein provided. Said treasurer shall in each case at once certify to the commissioner of agriculture the payment of such license fee.

Certificate of commissioner.

Each manufacturer, importer or person who has complied with the provisions of this article shall be entitled to receive a certificate from the commissioner of agriculture setting forth said facts. Such certificate shall expire on the thirty-first day of December of the calendar year in which it was issued, but no such certificate shall be issued for the sale of a brand of concentrated commercial feeding stuff under a brand or trade name which is misleading or deceptive or which tends to mislead or deceive as to the constituents or materials of which it is composed.

Cancellation of.

Any such certificate so issued may be cancelled by the commissioner of agriculture when it is shown that any statement upon which it was issued is false or misleading. Whenever the manufacturer, importer or shipper of concentrated commercial feeding stuffs shall have filed the statement required by section one hundred and sixty-one of this article and paid the license fee as prescribed in this section, no agent or seller of such manufacturer, importer or shipper shall be required to file such statement or pay such fee. (*As amended by chapter* 317 *of the Laws of* 1909.)

§ 164. **Commissioner of agriculture to take samples for analysis; analysis to be made by director of experiment station.**—The commissioner of agriculture shall at least once in each year transmit to the New York agricultural experiment station for analysis at least one sample to be taken in the manner hereinafter prescribed, of the different concentrated commercial feeding stuffs sold or offered for sale under the provisions of this article. The said commissioner of agriculture or his duly authorized representative in taking samples shall take them in duplicate in the presence of at least one witness, and in the presence of such witness shall seal such samples and shall at the time of taking tender, and if accepted, deliver to the person apparently in charge one of such samples; the other sample the commissioner of agriculture shall cause to be analyzed. The director of said experiment station shall continue to analyze or cause to be analyzed such samples of concentrated commercial feeding stuffs taken under the provisions of this article as shall be submitted to him for that purpose by the commissioner of agriculture and shall report such analyses to the commissioner of agriculture, and for this purpose the New York agricultural experiment station may continue to employ chemists and incur such expenses as may be necessary to comply with the requirements of this article. The result of the analysis of the sample or samples so procured, together with such additional information as circumstances advise, shall be published in reports or bulletins from time to time.

Taking of samples.

Analysis of.

Publication.

§ 165. **Sale of adulterated meal or ground grains.**— No person shall adulterate any kind of meal or ground grain or other cattle food with milling or manufacturing offals, or any substance whatever, for the purpose of sale, unless the true composition, mixture or adulteration thereof is plainly marked or indicated upon the package containing the same or in which it is offered for sale: no person shall sell or offer for sale any meal or ground grain or other cattle food which has been so adulterated unless the true composition, mixture or adulteration is plainly marked or indicated upon the package containing the same, or in which it is offered for sale. (*As amended by chapter* 317 *of the Laws of* 1909.)

PENALTIES.

Section 52 of the Agricultural Law relates to penalties and is as follows:

§ 52. **Penalties.**— Every person violating any of the provisions of this chapter, shall forfeit to the people of the state of New York the sum of not less than fifty dollars nor more than one hundred

dollars for the first violation and not less than one hundred dollars nor more than two hundred dollars for the second and each subsequent violation. When such violation consists of the manufacture or production of any prohibited article, each day during which or any part of which such manufacture or production is carried on or continued, shall be deemed a separate violation. When the violation consists of the sale, or the offering or exposing for sale or exchange of any prohibited article or substance, the sale of each one of several packages shall constitute a separate violation, and each day on which any such article or substance is offered or exposed for sale or exchange shall constitute a separate violation. When the use of any such article or substance is prohibited, each day during which or any part of which said article or substance is so used or furnished for use, shall constitute a separate violation, and the furnishing of the same for use to each person to whom the same may be furnished shall constitute a separate violation. Whoever by himself or another violates any of the provisions of articles three, four, six, eight and nine or sections three hundred fourteen and three hundred fifteen of this chapter or of sections one hundred six, one hundred seven and one hundred eight of this chapter shall be guilty of a misdemeanor, and upon conviction shall be punished by a fine of not less than fifty dollars, nor more than two hundred dollars, or by imprisonment of not less than one month nor more than six months or by both such fine and imprisonment, for the first offense; and by six months' imprisonment for the second offense.

REPORT OF ANALYSES OF SAMPLES OF COMMERCIAL FERTILIZERS COLLECTED BY THE COMMISSIONER OF AGRICULTURE DURING 1913.*

There are presented in this bulletin the analyses † of samples of fertilizers collected by the Commissioner of Agriculture during 1913, and transmitted by him for analysis to the Director of the New York Agricultural Experiment Station, in accordance with the provisions of Article 9 of the Agricultural Law. These analyses and the accompanying information are published by said Director in accordance with the provisions of Section 224 of said Law.

Since many requests have been received for such data, it has been deemed best to give figures showing the current values of fertilizer ingredients, with an illustration of the method of applying these figures in determining the approximate commercial valuation of the different brands.

TRADE-VALUES OF PLANT-FOOD ELEMENTS IN RAW MATERIALS AND CHEMICALS.

The trade-values in the following schedule have been agreed upon by the Experiment Stations of Massachusetts, Rhode Island, Connecticut, New York, New Jersey and Vermont, as a result of study of the prices actually prevailing in the large markets of these states.

These trade-values represent, as nearly as can be estimated, the average prices at which, during the six months preceding March, the respective ingredients, *in the form of unmixed raw materials,*

* Reprint of Bulletin No. 371, December, 1913.

† The analyses herewith published are made in charge of the Chemical Department of the Station, the immediate oversight of the work being assigned to E. L. Baker, Associate Chemist.

could be bought at retail for cash in our large markets. These prices also correspond (except in case of available phosphoric acid) to the average wholesale prices for the six months preceding March, plus about 20 per ct., in case of goods for which there are wholesale quotations.

TRADE-VALUES OF PLANT-FOOD ELEMENTS IN RAW MATERIALS AND CHEMICALS.

	1912. Cts. per pound.
Nitrogen in ammonia salts	18½
" in nitrates	18½
Organic nitrogen in dry and fine-ground fish, meat and blood	20
" in fine-ground bone, tankage and mixed fertilizers	19
" in coarse bone and tankage	15
" in castor pomace and cottonseed meal	20
Phosphoric acid, water-soluble	4½
" citrate-soluble (reverted)	4
" in fine-ground fish, bone and tankage	4
" in cottonseed meal and castor-pomace	4
" in coarse fish, bone, tankage and ashes	3½
" in mixed fertilizers, insoluble in ammonium citrate or water.	2
Potash as high-grade sulphate, in forms free from muriates (chlorides), in ashes, etc	5¼
" in muriate	4¼
" in castor pomace and cottonseed meal	5

VALUATION AND COST OF FERTILIZERS.

The total cost (to the farmer) of a ton of commercial fertilizer may be regarded as consisting of the following elements: (1) Retail cash cost, in the market, of unmixed trade materials; (2) cost of mixing; (3) cost of transportation; (4) storage, commissions to agents and dealers, selling on long credit, bad debts, etc. While the *total cost* of a fertilizer is made up of several different elements, a *commercial valuation* includes only the first of the elements entering into the total cost, that is, the retail cash cost in the market of unmixed raw materials.

VALUATION AND AGRICULTURAL VALUE.

The *agricultural value* of a fertilizer depends upon its *crop-producing power*. A commercial valuation does not necessarily have any relation to crop-producing value on a given farm. For a particular soil and crop, a fertilizer of comparatively low com-

mercial valuation may have a higher agricultural value; while, for another crop on the same soil, or the same crop on another soil, the reverse might be true.

RULE FOR CALCULATING APPROXIMATE COMMERCIAL VALUATION OF MIXED FERTILIZERS ON BASIS OF TRADE-VALUES FOR 1913.

Multiply the percentage of nitrogen by 3.8.
Multiply the percentage of available phosphoric acid by 0.9.
Multiply the percentage of insoluble phosphoric acid (total minus available) by 0.4.
Multiply the percentage of potash by 1.0.

The sum of these 4 products will be the commercial valuation per ton on the basis taken.

Illustration.— The table of analyses shows a certain fertilizer to have the following composition: Nitrogen 2.52 per ct.; available phosphoric acid 6.31 per ct.; insoluble phosphoric acid .89 per ct.; potash 6.64 per ct. According to this method of valuation, the computation would be as follows:

Nitrogen	2.52 x 3.8	$9.58
Available phosphoric acid	6.31 x 0.9	5.70
Insoluble phosphoric acid	0.89 x 0.4	0.36
Potash	6.64 x 1.0	6.64
		$22.28

This rule assumes all the nitrogen to be organic and all the potash to be in the form of sulphate. If a considerable portion of nitrogen exists in the fertilizer as nitrate of soda or as sulphate of ammonia, and potash is present as muriate, the results are somewhat less.

Farmers should be warned against judging fertilizers by their valuations. A fertilizer, the cost of which comes chiefly from the phosphoric acid present, would value much lower commercially than a fertilizer with a high percentage of nitrogen, and yet the former might be the more profitable one for a given farmer to purchase.

ANALYSES OF SAMPLES OF FERTILIZERS

Name and Address of Manufacturer or Jobber.	Brand or trade name.	Locality where sample was taken.	Number.
American Agricultural Chem. Co., The, New York	Acme Fertilizer No. 2	Chateaugay	3762
American Agricultural Chem. Co., The, New York	Acme Potato and Garden Manure	Little Neck	3588
American Agricultural Chem. Co., The, New York	Acme Special Potato and Truck	Laurel	4162
American Agricultural Chem. Co., The, New York	Bone Meal	Glens Falls	4087
American Agricultural Chem. Co., The, New York	Bradley's Alkaline Phosphate and Potash	Cobleskill	3317
American Agricultural Chem. Co., The, New York	Bradley's Bay State	Schuylerville	4081
American Agricultural Chem. Co., The, New York	Bradley's B. D. Guano	Harrisville	2931
American Agricultural Chem. Co., The, New York	Bradley's B. D. Guano	Skaneateles	3515
American Agricultural Chem. Co., The, New York	Bradley's Bean & Potato Phosphate	Elma	5004
American Agricultural Chem. Co., The, New York	Bradley's Big Crop	Nichols	4423
American Agricultural Chem. Co., The, New York	Bradley's Circle Phosphate	Skaneateles	3516
American Agricultural Chem. Co., The, New York	Bradley's Excelsior Fish and Potash	Centre Moriches	4200
American Agricultural Chem. Co., The, New York	Bradley's Greyhound Fertilizer	Cincinnatus	3914
American Agricultural Chem. Co., The, New York	Bradley's Greyhound Fertilizer	Calverton	4168
American Agricultural Chem. Co., The, New York	Bradley's Half Century Fertilizer	Stephentown	4052
American Agricultural Chem. Co., The, New York	Bradley's King Philip	Brewster	3857
American Agricultural Chem. Co., The, New York	Bradley's Magic Phosphate	Moravia..........	4031

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid. Available.	Phosphoric acid. Total.	Potash.
3762	Guaranteed Found	4.94 4.53	8. 8.55	9. 9.83	5. 5.24
3588	Guaranteed Found	3.29 3.58	7. 7.18	8. 8.52	7. 7.32
4162	Guaranteed Found	3.29 3.26	8. 8.76	9. 9.46	7. 7.12
4087	Guaranteed Found	1.65 1.98	—— ——	13.73 20.69	—— ——
3317	Guaranteed Found	—— ——	10. 11.01	11. 12.05	2. 1.90
4081	Guaranteed Found	1.65 1.79	5. 5.51	6. 6.15	10. 10.44
2931	Guaranteed Found	.82 1.03	8. 8.23	9. 9.09	4. 4.38
3515	Guaranteed Found	.82 .92	8. 8.12	9. 9.34	4. 3.82
5004	Guaranteed Found	.82 1.00	8. 7.78	9. 9.09	4. 4.22
4423	Guaranteed Found	—— ——	8. 8.33	9. 8.83	5. 5.42
3516	Guaranteed Found	—— ——	10. 10.72	11. 11.44	8. 8.08
4200	Guaranteed Found	2.47 2.65	4. 4.89	5. 6.15	4. 4.98
3914	Guaranteed Found	3.29 3.28	6. 6.59	7. 7.93	10. 10.66
4168	Guaranteed Found	3.29 3.33	6. 6.81	7. 7.91	10. 10.02
4052	Guaranteed Found	2.06 2.13	8. 8.21	9. 9.89	3. 2.98
3857	Guaranteed Found	1.08 1.16	8. 8.90	9. 10.16	2. 2.82
4031	Guaranteed Found	—— ——	12. 12.01	13. 12.84	5. 4.98

ANALYSES OF SAMPLES OF FERTILIZERS

NAME AND ADDRESS OF MANUFACTURER OR JOBBER.	Brand or trade name.	Locality where sample was taken.	Number.
American Agricultural Chem. Co., The, New York	Bradley's Maize Producer	Ellenburg Depot	3769
American Agricultural Chem. Co., The, New York	Bradley's New Method Fertilizer	Schuylerville	4079
American Agricultural Chem. Co., The, New York	Bradley's New Rival Fertilizer	Afton	4364
American Agricultural Chem. Co., The, New York	Bradley's Niagara Phosphate	Skaneateles	3510
American Agricultural Chem. Co., The, New York	Bradley's Patent Super Phosphate	Skaneateles	3514
American Agricultural Chem. Co., The, New York	Bradley's Potato and Truck Grower	Amsterdam	3687
American Agricultural Chem. Co., The, New York	Bradley's Potato & Vegetable Manure	Eagle Bridge	4066
American Agricultural Chem. Co., The, New York	Bradley's Potato & Vegetable Manure	Sherburne	4120
American Agricultural Chem. Co., The, New York	Bradley's Potato Fertilizer	Amsterdam	3683
American Agricultural Chem. Co., The, New York	Bradley's Retriever Manure	Harrisville	2932
American Agricultural Chem. Co., The, New York	Bradley's Soluble Dissolved Phosphate	Newark Valley	4425
American Agricultural Chem. Co., The, New York	Bradley's Superior Compound	Schuylerville	4080
American Agricultural Chem. Co., The, New York	Bradley's Tobacco Manure	Elmira	4495
American Agricultural Chem. Co., The, New York	Bradley's Unicorn	Skaneateles	3512
American Agricultural Chem. Co., The, New York	Bradley's Weymouth Staple Phosphate	Skaneateles	3511
American Agricultural Chem. Co., The, New York	Canner's Pea & Bean Special Fertilizer	Collins	3354
American Agricultural Chem. Co., The, New York	Clark's Cove King Philip Alkaline Guano	Orchard Park	4334

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid. Available.	Phosphoric acid. Total.	Potash.
3769	Guaranteed Found	2.06 2.13	8. 7.73	9. 9.08	6. 6.70
4079	Guaranteed Found	.82 .96	8. 8.34	9. 9.56	2. 2.34
4364	Guaranteed Found	1.23 1.27	6. 6.72	7. 8.42	5. 5.16
3510	Guaranteed Found	.82 .97	7. 7.77	8. 9.49	1. 1.40
3514	Guaranteed Found	2.06 2.07	8. 8.64	9. 10.26	1.50 1.94
3687	Guaranteed Found	1.65 1.64	8. 8.70	9. 9.78	10. 9.49
4066	Guaranteed Found	3.29 3.29	8. 8.66	9. 9.76	7. 7.34
4120	Guaranteed Found	3.29 3.30	8. 8.43	9. 9.85	7. 7.04
3683	Guaranteed Found	2.06 1.94	8. 8.58	9. 9.90	3. 3.07
2932	Guaranteed Found	2.47 2.46	6. 6.66	7. 7.72	5. 6.
4425	Guaranteed Found	—— ——	14. 13.91	15. 14.31	—— ——
4080	Guaranteed Found	.82 .97	9. 9.18	10. 10.16	7. 7.56
4495	Guaranteed Found	4.53 3.80	3. 3.99	4. 4.97	5.50 5.54
3512	Guaranteed Found	1.65 1.68	8. 7.67	9. 9.14	2. 2.70
3511	Guaranteed Found	1.65 1.72	8. 7.64	9. 9.36	10. 10.50
3354	Guaranteed Found	.82 .94	7. 7.64	8. 8.66	9. 8.83
4334	Guaranteed Found	1.03 1.01	8. 7.53	9. 8.80	2. 2.36

ANALYSES OF SAMPLES OF FERTILIZERS

NAME AND ADDRESS OF MANUFACTURER OR JOBBER.	Brand or trade name.	Locality where sample was taken.	Number.
American Agricultural Chem. Co., The, New York	Clark's Cove Potato & Hop Grower	Spring Valley	4551
American Agricultural Chem. Co., The, New York	Crocker's Ammoniated Superphosphate	Truxton	3934
American Agricultural Chem. Co., The, New York	Crocker's Cabbage & Potato Manure	Lewiston	4305
American Agricultural Chem. Co., The, New York	Crocker's Century Fertilizer	Truxton	3932
American Agricultural Chem. Co., The, New York	Crocker's Colonial Fertilizer	Canastota	4357
American Agricultural Chem. Co., The, New York	Crocker's Complete Manure	East Aurora	3262
American Agricultural Chem. Co., The, New York	Crocker's Dissolved Phosphate & Potash	Cherry Valley	3327
American Agricultural Chem. Co., The, New York	Crocker's Double Strength Manure	Cortland	3942
American Agricultural Chem. Co., The, New York	Crocker's General Crop Fertilizer	East Aurora	3259
American Agricultural Chem. Co., The, New York	Crocker's Globe Phosphate	East Aurora	3260
American Agricultural Chem. Co., The, New York	Crocker's Grain Grower	Linwood	4467
American Agricultural Chem. Co., The, New York	Crocker's Harvest Jewel Fertilizer	Truxton	3933
American Agricultural Chem. Co., The, New York	Crocker's High Grade Potato Fertilizer	Sterling	3732
American Agricultural Chem. Co., The, New York	Crocker's High Grade Special Fertilizer	Gasport	3801
American Agricultural Chem. Co., The, New York	Crocker's Nobsque Guano	Sharon Springs	3335
American Agricultural Chem. Co., The, New York	Crocker's Paragon Phosphate	Cobleskill	3314
American Agricultural Chem. Co., The, New York	Crocker's Rainbow Phosphate	Sharon Springs	3336

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric Acid.		Potash.
			Available.	Total.	
4551	Guaranteed Found	.82 1.06	8. 8.50	9. 9.28	4. 4.36
3934	Guaranteed Found	2.47 2.64	9. 9.34	10. 10.66	2. 2.70
4305	Guaranteed Found	2.47 2.43	8. 7.66	9. 9.30	6. 6.40
3932	Guaranteed Found	1.65 1.67	5. 8.12	6. 8.82	10. 10.40
4357	Guaranteed Found	2.47 2.26	6. 7.27	7. 8.35	10. 10.32
3262	Guaranteed Found	.82 .98	8. 8.15	9. 8.95	4. 3.92
3327	Guaranteed Found	—— ——	10. 10.99	11. 11.63	2. 2.52
3942	Guaranteed Found	3.29 3.03	8. 8.67	9. 9.59	10. 9.74
3259	Guaranteed Found	.82 .88	7. 7.45	8. 8.63	1. 1.46
3260	Guaranteed Found	—— ——	10. 9.37	11. 9.69	8. 8.06
4467	Guaranteed Found	1.65 1.55	10. 8.95	11. 10.34	4. 4.58
3933	Guaranteed Found	1.65 1.84	8. 8.70	9. 9.54	2. 2.46
3732	Guaranteed Found	3.29 3.30	6. 6.74	7. 7.66	10. 10.42
3801	Guaranteed Found	1.65 1.79	8. 8.20	9. 9.16	4. 3.63
3335	Guaranteed Found	1.03 1.15	8. 8.66	9. 10.14	2. 2.64
3314	Guaranteed Found	—— ——	12. 11.77	13. 12.31	5. 4.81
3336	Guaranteed Found	2.06 2.03	8. 8.96	9. 10.34	3. 3.14

ANALYSES OF SAMPLES OF FERTILIZERS

Name and Address of Manufacturer or Jobber.	Brand or trade name.	Locality where sample was taken.	Number.
American Agricultural Chem. Co., The, New York	Crocker's Root and Vine	Caledonia	3958
American Agricultural Chem. Co., The, New York	Crocker's Special Potato Manure	Cobleskill	3315
American Agricultural Chem. Co., The, New York	Crocker's Universal Grain Grower	East Aurora	3254
American Agricultural Chem. Co., The, New York	Crocker's Wheat and Corn Fertilizer	Cobleskill	3312
American Agricultural Chem. Co., The, New York	Darling's Blood, Bone and Potash	Laurel	4161
American Agricultural Chem. Co., The, New York	Darling's Long Island "A"	Bridgehampton	4194
American Agricultural Chem. Co., The, New York	Dry Ground Fish	Calverton	4169
American Agricultural Chem. Co., The, New York	East India Black Hawk Fertilizer	Cortland	3938
American Agricultural Chem. Co., The, New York	East India Corn King	Deposit	4115
American Agricultural Chem. Co., The, New York	East India Economizer Phosphate	Poughkeepsie	3882
American Agricultural Chem. Co., The, New York	East India Farm Favorite	Deposit	4118
American Agricultural Chem. Co., The, New York	East India Fish and Potash	East Marion	4178
American Agricultural Chem. Co., The, New York	East India Fruit Grower's Friend	Cortland	3940
American Agricultural Chem. Co., The, New York	East India Garden and Farm Manure	New Hyde Park	3592
American Agricultural Chem. Co., The, New York	East India Hawkeye Fertilizer	Cairo	3891
American Agricultural Chem. Co., The, New York	East India Hustler Phosphate	Mapleton	4433
American Agricultural Chem. Co., The, New York	East India Improved Compound	Deposit	4117

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid. Available.	Phosphoric acid. Total.	Potash.
3958	Guaranteed Found	.82 1.00	9. 8.96	10. 9.76	7. 7.06
3315	Guaranteed Found	3.29 3.24	8. 8.62	9. 9.94	7. 6.96
3254	Guaranteed Found	.82 .88	8. 8.38	9. 10.32	2. 2.12
3312	Guaranteed Found	2.06 2.05	8. 8.82	9. 10.62	1.50 1.80
4161	Guaranteed Found	4.11 4.03	7. 7.83	8. 8.89	7. 7.32
4194	Guaranteed Found	3.29 3.28	8. 8.56	9. 9.96	7. 7.34
4169	Guaranteed Found	8.23 8.93	—— ——	6. 7.56	—— ——
3938	Guaranteed Found	2.47 2.72	9. 9.25	10. 10.59	2. 2.66
4115	Guaranteed Found	2.47 2.53	8. 9.01	9. 10.65	6. 6.26
3882	Guaranteed Found	.82 1.02	8. 8.06	9. 9.76	2. 2.28
4118	Guaranteed Found	—— ——	10. 10.33	11. 10.73	8. 8.20
4178	Guaranteed Found	2.47 2.71	4. 4.90	5. 6.22	4. 5.10
3940	Guaranteed Found	.82 .94	9. 9.12	10. 10.66	7. 7.
3592	Guaranteed Found	3.29 3.37	8. 8.54	9. 9.78	7. 7.18
3891	Guaranteed Found	.82 1.06	7. 7.37	9. 8.71	1. 1.44
4433	Guaranteed Found	.82 .87	9. 10.26	10. 11.25	3. 3.06
4117	Guaranteed Found	1.65 1.86	5. 5.70	6. 6.18	10. 10.46

ANALYSES OF SAMPLES OF FERTILIZERS

NAME AND ADDRESS OF MANUFACTURER OR JOBBER.	Brand or trade name.	Locality where sample was taken.	Number.
American Agricultural Chem. Co., The, New York	East India Mayflower	Kirkwood	4668
American Agricultural Chem. Co., The, New York	East India Monarch Phosphate	Kirkwood	4667
American Agricultural Chem. Co., The, New York	East India Pilgrim Fertilizer	Binghamton	4131
American Agricultural Chem. Co., The, New York	East India Potato Manure	Cairo	3892
American Agricultural Chem. Co., The, New York	East India Roanoke Phosphate	Southampton	4189
American Agricultural Chem. Co., The, New York	East India Sea Fowl Guano	Cazenovia	4658
American Agricultural Chem. Co., The, New York	East India 10% Vegetable and Potato	Fulton	4223
American Agricultural Chem. Co., The, New York	East India Tiger Brand	Cazenovia	4657
American Agricultural Chem. Co., The, New York	East India Vegetable, Vine & Potato Manure	Binghamton	4130
American Agricultural Chem. Co., The, New York	East India Victor Special	Deposit	4116
American Agricultural Chem. Co., The, New York	Fine Ground Bone	East Aurora	3253
American Agricultural Chem. Co., The, New York	Fine Ground Bone	Collins	3358
American Agricultural Chem. Co., The, New York	14% Acid Phosphate	Brockport	3465
American Agricultural Chem. Co., The, New York	Genuine German Kainit	Cortland	3939
American Agricultural Chem. Co., The, New York	Grass and Lawn Top Dressing	Brewster	3858
American Agricultural Chem. Co., The, New York	Great Eastern Garden Special	Locust Valley	3565
American Agricultural Chem. Co., The, New York	Great Eastern General	Delanson	3345

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid. Available.	Phosphoric acid. Total.	Potash.
4668	Guaranteed	1.65	8.	9.	2.
	Found	1.71	8.35	9.80	2.63
4667	Guaranteed	——	12.	13.	5.
	Found	——	12.27	12.83	5.52
4131	Guaranteed	.82	8.	9.	4.
	Found	.91	8.47	9.75	4.48
3892	Guaranteed	3.29	6.	7.	10.
	Found	3.46	7.27	8.11	10.90
4189	Guaranteed	1.03	8.	9.	2.
	Found	1.35	8.68	10.08	2.14
4658	Guaranteed	2.06	8.	9.	1.50
	Found	1.97	8.19	10.03	1.86
4223	Guaranteed	1.65	8.	9.	10.
	Found	1.82	8.09	9.73	10.23
4657	Guaranteed	1.23	6.	7.	5.
	Found	1.41	6.63	8.57	5.32
4130	Guaranteed	2.47	6.	7.	10.
	Found	2.62	6.74	8.60	10.58
4116	Guaranteed	3.29	8.	9.	10.
	Found	3.59	8.46	9.32	11.22
3253	Guaranteed	2.47	——	22.88	——
	Found	2.55	——	26.03	——
3358	Guaranteed	2.47	——	22.88	——
	Found	2.94	——	23.54	——
3465	Guaranteed	——	14.	15.	——
	Found	——	13.36	13.88	——
3939	Guaranteed	——	——	——	12.
	Found	——	——	——	12.54
3858	Guaranteed	3.91	5.	6.	2.
	Found	4.08	5.72	7.12	2.56
3565	Guaranteed	3.29	8.	9.	7.
	Found	3.40	8.39	9.71	7.24
3345	Guaranteed	.82	8.	9.	4.
	Found	.91	8.84	9.96	4.40

ANALYSES OF SAMPLES OF FERTILIZERS

NAME AND ADDRESS OF MANUFACTURER OR JOBBER.	Brand or trade name.	Locality where sample was taken.	Number.
American Agricultural Chem. Co., The, New York	Great Eastern New York Potato Special	Afton	4368
American Agricultural Chem. Co., The, New York	Great Eastern Northern Corn Special	Jamestown	4281
American Agricultural Chem. Co., The, New York	Great Eastern Peerless Potato Manure	Delanson	3344
American Agricultural Chem. Co., The, New York	Great Eastern Schodack Special	Hillsdale	3887
American Agricultural Chem. Co., The, New York	Great Eastern Soluble Bone and Potash	Sherburne	4122
American Agricultural Chem. Co., The, New York	Great Eastern Unammoniated Wheat Special	Sherburne	4123
American Agricultural Chem. Co., The, New York	Great Eastern Vegetable, Vine and Tobacco Fertilizer	Schuylers Lake	4212
American Agricultural Chem. Co., The, New York	Ground Tankage 9–20	Southampton	4190
American Agricultural Chem. Co., The, New York	Ground Tankage 6–30	Tarrytown	3877
American Agricultural Chem. Co., The, New York	High Grade Celery, Onion and Truck Manure	York	4042
American Agricultural Chem. Co., The, New York	High Grade Dried Blood	Brockport	3464
American Agricultural Chem. Co., The, New York	High Grade Ground Bone	East Aurora	3252
American Agricultural Chem. Co., The, New York	High Grade Ground Bone	Hamburg	3384
American Agricultural Chem. Co., The, New York	High Grade Potash Compound	Chili	3484
American Agricultural Chem. Co., The, New York	High Grade Sulphate of Potash	Cortland	3941
American Agricultural Chem. Co., The, New York	Lazaretto "AA" Superphosphate	Webster	4004
American Agricultural Chem. Co., The, New York	Lazaretto Dissolved Phosphate	Webster	4001

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid.		Potash.
			Available.	Total.	
4368	Guaranteed Found	1.85 1.86	7. 8.25	8. 9.13	10. 10.10
4281	Guaranteed Found	2.47 2.47	9. 8.16	10. 9.42	2. 2.85
3344	Guaranteed Found	1.03 1.14	7. 7.57	8. 8.33	10. 10.08
3887	Guaranteed Found	.82 .97	9. 9.07	10. 10.59	7. 6.37
4122	Guaranteed Found	—— ——	11. 12.05	12. 13.07	2. 2.16
4123	Guaranteed Found	—— ——	12. 12.65	13. 13.87	—— ——
4212	Guaranteed Found	2.06 2.13	8. 8.40	9. 9.70	3. 3.30
4190	Guaranteed Found	7.41 7.87	—— ——	9.15 8.68	—— ——
3877	Guaranteed Found	4.94 5.08	—— ——	13.73 15.33	—— ——
4042	Guaranteed Found	4.11 3.83	4. 4.64	5. 5.92	12. 11.36
3464	Guaranteed Found	9.87 9.85	—— ——	—— ——	—— ——
3252	Guaranteed Found	3.29 3.61	—— ——	20.59 20.14	—— ——
3384	Guaranteed Found	3.29 3.38	—— ——	20.59 21.21	—— ——
3484	Guaranteed Found	1.65 1.86	8. 8.08	9. 8.80	10. 9.78
3941	Guaranteed Found	—— ——	—— ——	—— ——	48. 50.38
4004	Guaranteed Found	1.85 1.51	9. 9.05	10. 11.14	4. 3.16
4001	Guaranteed Found	—— ——	14. 14.08	15. 14.40	—— ——

ANALYSES OF SAMPLES OF FERTILIZERS

Name and Address of Manufacturer or Jobber.	Brand or trade name.	Locality where sample was taken.	Number.
American Agricultural Chem. Co., The, New York	Lazaretto Extra Ammoniated Bone Phosphate	Webster	4002
American Agricultural Chem. Co., The, New York	Lazaretto High Grade Alkaline Dissolved Bone	Webster	4003
American Agricultural Chem. Co., The, New York	Michigan Carbon Works General Crop Fertilizer	Middleport	3849
American Agricultural Chem. Co., The, New York	Michigan Carbon Works Homestead Fertilizer	North Collins	3296
American Agricultural Chem. Co., The, New York	Michigan Carbon Works Homestead Fertilizer	Cato	4026
American Agricultural Chem. Co., The, New York	Michigan Carbon Works Homestead Potato and Tobacco Fertilizer	Middleport	3850
American Agricultural Chem. Co., The, New York	Michigan Carbon Works Red Line Complete Fertilizer	Spencerport	4451
American Agricultural Chem. Co., The, New York	Michigan Carbon Works Red Line Phosphate with Potash	Fredonia	4264
American Agricultural Chem. Co., The, New York	Milsom's Buffalo Fertilizer	Canandaigua	3990
American Agricultural Chem. Co., The, New York	Milsom's Buffalo Guano	Croghan	2923
American Agricultural Chem. Co., The, New York	Milsom's Corn Fertilizer	Collins	3369
American Agricultural Chem. Co., The, New York	Milsom's Crown Phosphate	Union Center	4101
American Agricultural Chem. Co., The, New York	Milsom's Eclipse Phosphate	Albion	3830
American Agricultural Chem. Co., The, New York	Milsom's Erie King Fertilizer	Eagle Bridge	4064
American Agricultural Chem. Co., The, New York	Milsom's Fancy Fruit Grower	Mumford	3962
American Agricultural Chem. Co., The, New York	Milsom's Imperial Phosphate	Mumford	3960

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid. Available.	Phosphoric acid. Total.	Potash.
4002	Guaranteed Found	.82 .96	8. 8.10	9. 9.16	4. 4.16
4003	Guaranteed Found	—— ——	10. 10.06	11. 10.46	8. 5.30
3849	Guaranteed Found	.82 1.04	8. 9.13	9. 10.43	4. 3.58
3296	Guaranteed Found	2.06 2.08	8. 7.19	9. 8.52	1.50 1.64
4026	Guaranteed Found	2.06 2.08	8. 8.98	9. 9.80	1.50 1.74
3850	Guaranteed Found	2.06 2.12	8. 8.61	9. 9.79	3. 2.57
4451	Guaranteed Found	.82 .97	7. 7.30	8. 8.28	1. 1.34
4264	Guaranteed Found	—— ——	10. 9.55	11. 10.13	2. 2.83
3990	Guaranteed Found	2.06 2.10	8. 8.80	9. 9.90	1.50 1.62
2923	Guaranteed Found	.82 .92	8. 8.48	9. 9.86	4. 4.06
3369	Guaranteed Found	2.47 1.08	9. 8.65	10. 10.32	2. 3.41
4101	Guaranteed Found	—— ——	10. 10.80	11. 11.74	2. 1.82
3830	Guaranteed Found	—— ——	10. 10.20	11. 10.64	8. 8.12
4064	Guaranteed Found	.82 .88	7. 7.66	8. 9.14	1. 1.26
3962	Guaranteed Found	.82 1.07	9. 8.80	10. 9.97	7. 7.26
3960	Guaranteed Found	—— ——	12. 12.06	13. 12.32	5. 5.22

ANALYSES OF SAMPLES OF FERTILIZERS

Name and Address of Manufacturer or Jobber.	Brand or trade name.	Locality where sample was taken.	Number.
American Agricultural Chem. Co., The, New York	Milsom's Harrow Brand Phosphate	Canandaigua	3991
American Agricultural Chem. Co., The, New York	Milsom's Medal Brand Manure	Union Center	3549
American Agricultural Chem. Co., The, New York	Milsom's Old Pilot Phosphate	Union Center	4102
American Agricultural Chem. Co., The, New York	Milsom's Potato and Truck Grower	Walker	3968
American Agricultural Chem. Co., The, New York	Milsom's Soil Enricher	Lockport	3811
American Agricultural Chem. Co., The, New York	Milsom's Vegetable Fertilizer	North Collins	3295
American Agricultural Chem. Co., The, New York	Milsom's Wheat, Oats and Barley Fertilizer	Lockport	3810
American Agricultural Chem. Co., The, New York	Muriate of Potash	Brockport	3466
American Agricultural Chem. Co., The, New York	Nitrate of Soda	North Syracuse	3526
American Agricultural Chem. Co., The, New York	North Western Challenge Fertilizer	Rhinebeck	3885
American Agricultural Chem. Co., The, New York	North Western Complete Compound	Brockport	3467
American Agricultural Chem. Co., The, New York	North Western Diamond Potash Mixture	East Aurora	3261
American Agricultural Chem. Co., The, New York	North Western Earth Warmer Phosphate	Lestershire	4665
American Agricultural Chem. Co., The, New York	North Western Electric Phosphate	Voorheesville	3347
American Agricultural Chem. Co., The, New York	North Western Farmers' Standard	Lestershire	4664
American Agricultural Chem. Co., The, New York	North Western 14% Acid Phosphate	Penn Yan	4509
American Agricultural Chem. Co., The, New York	North Western Garden Manure	Poughkeepsie	3884

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen	Phosphoric Acid. Available.	Phosphoric Acid. Total.	Potash.
3991	Guaranteed Found	2.47 2.44	6. 6.99	7. 7.99	10. 8.26
3549	Guaranteed Found	3.29 3.26	6. 7.02	7. 7.76	10. 9.81
4102	Guaranteed Found	2.06 2.06	8. 8.79	9. 9.39	3. 3.28
3968	Guaranteed Found	1.65 1.68	8. 7.29	9. 9.49	10. 10.36
3811	Guaranteed Found	1.65 1.71	8. 7.51	9. 8.37	4. 4.60
3295	Guaranteed Found	3.29 3.24	8. 7.93	9. 9.53	7. 6.96
3810	Guaranteed Found	.82 .91	8. 8.03	9. 9.07	2. 2.26
3466	Guaranteed Found	—— ——	—— ——	—— ——	49. 48.
3526	Guaranteed Found	15. 15.56	—— ——	—— ——	—— ——
3885	Guaranteed Found	1.08 1.20	8. 8.69	9. 9.95	2. 2.60
3467	Guaranteed Found	.82 .84	8. 8.21	9. 8.95	4. 4.28
3261	Guaranteed Found	1.65 1.67	8. 8.44	9. 9.48	10. 9.04
4665	Guaranteed Found	2.47 2.45	6. 6.35	7. 7.19	10. 10.80
3347	Guaranteed Found	—— ——	10. 10.83	11. 11.79	2. 1.79
4664	Guaranteed Found	1.23 1.50	6. 7.08	7. 8.08	5. 5.76
4509	Guaranteed Found	—— ——	14. 15.76	15. 16.16	—— ——
3884	Guaranteed Found	3.29 3.38	8. 8.89	9. 9.89	7. 7.42

ANALYSES OF SAMPLES OF FERTILIZERS

NAME AND ADDRESS OF MANUFACTURER OR JOBBER.	Brand or trade name.	Locality where sample was taken.	Number.
American Agricultural Chem. Co., The, New York	North Western High Grade Alkaline Phosphate	Darien Center	3953
American Agricultural Chem. Co., The, New York	North Western Grain Fertilizer	Marcellus	4653
American Agricultural Chem. Co., The, New York	North Western Homestead Fertilizer	So. Lansing	4410
American Agricultural Chem. Co., The, New York	North Western Horse Shoe Brand	Ithaca	4405
American Agricultural Chem. Co., The, New York	North Western Pride of the North	Chateaugay	3763
American Agricultural Chem. Co., The, New York	North Western Puritan Phosphate	Malone	3754
American Agricultural Chem. Co., The, New York	North Western Red Line Fertilizer	Elba	4477
American Agricultural Chem. Co., The, New York	North Western Shawnee Phosphate	Darien Center	3954
American Agricultural Chem. Co., The, New York	North Western Soluble Fertilizer	Marcellus	4654
American Agricultural Chem. Co., The, New York	North Western Success Phosphate	Catskill	3890
American Agricultural Chem. Co., The, New York	North Western Top Notch Manure	Lestershire	4663
American Agricultural Chem. Co., The, New York	Pacific Nobsque Guano	Alton	3725
American Agricultural Chem. Co., The, New York	Pacific Soluble Guano	Alton	3726
American Agricultural Chem. Co., The, New York	Packer's Union Animal Corn Fertilizer	Afton	4367
American Agricultural Chem. Co., The, New York	Packer's Union Gardeners Complete Manure	Afton	4365
American Agricultural Chem. Co., The, New York	Packer's Union Potato Manure	Babylon	4603

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid.		Potash.
			Available.	Total.	
3953	Guaranteed Found	—— ——	10. 9.42	11. 9.82	8. 7.09
4653	Guaranteed Found	1.65 1.84	10. 9.22	11. 10.31	4. 4.58
4410	Guaranteed Found	2.06 2.05	8. 8.83	9. 10.19	1.50 1.94
4405	Guaranteed Found	—— ——	12. 12.35	13. 13.69	5. 4.98
3763	Guaranteed Found	1.65 1.58	6. 5.67	6. 6.45	10. 10.52
3754	Guaranteed Found	.82 .96	9. 9.12	10. 10.98	7. 7.20
4477	Guaranteed Found	2.47 2.43	8. 7.96	9. 9.36	6. 6.
3954	Guaranteed Found	1.65 1.66	8. 8.38	9. 9.54	4. 4.20
4654	Guaranteed Found	3.29 3.05	6. 6.60	7. 7.72	10. 10.82
3890	Guaranteed Found	.82 .95	7. 7.23	8. 9.71	1. 1.32
4663	Guaranteed Found	3.29 3.91	8. 8.19	9. 9.13	10. 10.08
3725	Guaranteed Found	1. .98	8. 8.02	9. 9.34	2. 2.50
3726	Guaranteed Found	2.06 2.23	8. 7.25	9. 8.59	1.50 1.76
4367	Guaranteed Found	2.47 2.57	9. 9.32	10. 10.82	2. 2.60
4365	Guaranteed Found	3.29 3.07	6. 6.64	7. 8.10	10. 9.70
4603	Guaranteed Found	2.06 2.27	8. 9.14	9. 10.38	6. 6.64

ANALYSES OF SAMPLES OF FERTILIZERS

NAME AND ADDRESS OF MANUFACTURER OR JOBBER.	Brand or trade name.	Locality where sample was taken.	Number.
American Agricultural Chem. Co., The, New York	Packer's Union Universal Fertilizer	West Nyack	4553
American Agricultural Chem. Co., The, New York	Potato and Garden Manure	York	4043
American Agricultural Chem. Co., The, New York	Potato and Onion Special	Bergen	3480
American Agricultural Chem. Co., The, New York	Pulverized Sheep Manure	Freeport	3558
American Agricultural Chem. Co., The, New York	Pure Unleached Canada Hardwood Ashes	New York	4614
American Agricultural Chem. Co., The, New York	Quinnipiac Ammoniated Dissolved Bone	Darien Center	3952
American Agricultural Chem. Co., The, New York	Quinnipiac "B" Fertilizer	Stephentown	4056
American Agricultural Chem. Co., The, New York	Quinnipiac Climax Phosphate	Stephentown	4055
American Agricultural Chem. Co., The, New York	Quinnipiac Dissolved Phosphate and Potash	Newark Valley	4426
American Agricultural Chem. Co., The, New York	Quinnipiac Market Garden Manure	Hicksville	3551
American Agricultural Chem. Co., The, New York	Quinnipiac Potato Manure	Stephentown	4057
American Agricultural Chem. Co., The, New York	Quinnipiac Potato Phosphate	Stephentown	4054
American Agricultural Chem. Co., The, New York	Read's Champion Phosphate	Collins	3360
American Agricultural Chem. Co., The, New York	Read's Corn, Wheat and Rye	North Syracuse	3529
American Agricultural Chem. Co., The, New York	Read's Farmer's Friend Super Phosphate	Malone	3757
American Agricultural Chem. Co., The, New York	Read's Farmer's Reliable	Baldwinsville	4129
American Agricultural Chem. Co., The, New York	Read's High Grade Farmer's Friend	North Syracuse	3524

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid. Available.	Phosphoric acid. Total.	Potash.
4553	Guaranteed	.82	8.	9.	4.
	Found	1.04	8.65	10.31	4.66
4043	Guaranteed	3.29	7.	8.	7.
	Found	2.87	7.73	8.75	7.14
3480	Guaranteed	1.65	10.	11.	6.
	Found	1.79	9.34	10.69	5.60
3558	Guaranteed	2.06	.50	1.25	.50
	Found	2.28	1.46	1.54	2.38
4614	Guaranteed	——	——	——	2.
	Found	——	——	1.39	3.54
3952	Guaranteed	1.65	8.	9.	2.
	Found	1.70	7.77	9.91	2.22
4056	Guaranteed	.82	8.	9.	4.
	Found	.95	8.30	9.16	4.22
4055	Guaranteed	1.03	8.	9.	2.
	Found	1.21	8.15	9.57	2.18
4426	Guaranteed	——	10.	11.	2.
	Found	——	10.33	10.63	2.22
3551	Guaranteed	3.29	8.	9.	7.
	Found	3.40	8.21	9.85	7.12
4057	Guaranteed	2.47	6.	7.	5.
	Found	2.42	6.53	7.39	5.50
4054	Guaranteed	2.06	8.	9.	3.
	Found	2.05	8.37	9.73	3.16
3360	Guaranteed	——	10.	11.	2.
	Found	——	10.40	10.64	2.04
3529	Guaranteed	1.65	8.	9.	4.
	Found	1.73	7.96	9.48	4.50
3757	Guaranteed	2.06	8.	9.	3.
	Found	1.96	8.38	9.72	3.16
4139	Guaranteed	——	12.	13.	5.
	Found	——	12.04	12.86	5.26
3524	Guaranteed	3.29	6.	7.	10.
	Found	3.03	7.01	7.89	10.64

ANALYSES OF SAMPLES OF FERTILIZERS

NAME AND ADDRESS OF MANUFACTURER OR JOBBER.	Brand or trade name.	Locality where sample was taken.	Number.
American Agricultural Chem. Co., The, New York	Read's Leader Fertilizer	Williamsville	3385
American Agricultural Chem. Co., The, New York	Read's Lion Crop Grower	North Syracuse	3521
American Agricultural Chem. Co., The, New York	Read's Oriole Fertilizer	North Syracuse	3522
American Agricultural Chem. Co., The, New York	Read's Pioneer Fertilizer	Center Village	4391
American Agricultural Chem. Co., The, New York	Read's Potash Compound	Collins	3359
American Agricultural Chem. Co., The, New York	Read's Potato Manure	Amber	3547
American Agricultural Chem. Co., The, New York	Read's Practical Potato Special	North Syracuse	3523
American Agricultural Chem. Co., The, New York	Read's Standard Super Phosphate	Collins	3355
American Agricultural Chem. Co., The, New York	Read's 10 and 8	North Syracuse	3528
American Agricultural Chem. Co., The, New York	Read's Truck Fertilizer	Lynbrook	3573
American Agricultural Chem. Co., The, New York	Read's Vegetable and Vine	Lynbrook	3574
American Agricultural Chem. Co., The, New York	Reese's Challenge Crop Grower	La Salle	4316
American Agricultural Chem. Co., The, New York	Reese's Crown Phosphate and Potash	East Bethany	4452
American Agricultural Chem. Co., The, New York	Reese's Elm Phosphate	Perry	4463
American Agricultural Chem. Co., The, New York	Reese's Mayflower	Walker	4518
American Agricultural Chem. Co., The, New York	Reese's Pilgrim Fertilizer	Ballston Spa.	4095
American Agricultural Chem. Co., The, New York	Reese's Potato Manure	La Salle	4317

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid.		Potash.
			Available.	Total.	
3385	Guaranteed	.82	7.	8.	1.
	Found	.88	7.13	8.33	1.38
3521	Guaranteed	1.23	6.	7.	5.
	Found	1.24	6.82	8.60	5.34
3522	Guaranteed	2.47	6.	7.	5.
	Found	2.32	7.01	7.95	5.96
4391	Guaranteed	.82	8.	9.	2.
	Found	1.15	8.37	9.91	2.36
3359	Guaranteed	1.65	8.	9.	10.
	Found	1.63	7.26	9.22	9.92
3547	Guaranteed	2.47	6.	7.	10.
	Found	2.42	7.07	7.95	9.94
3523	Guaranteed	.82	4.	5.	8.
	Found	.85	6.13	6.99	8.22
3355	Guaranteed	.82	8.	9.	4.
	Found	.95	7.94	8.90	4.02
3528	Guaranteed	——	10.	11.	8.
	Found	——	11.16	11.56	6.91
3573	Guaranteed	3.29	8.	9.	7.
	Found	3.41	8.23	9.75	7.40
3574	Guaranteed	2.06	8.	9.	6.
	Found	2.53	7.99	10.24	4.47
4316	Guaranteed	.82	8.	9.	2.
	Found	.97	8.54	9.52	2.34
4452	Guaranteed	——	11.	12.	2.
	Found	——	11.28	11.91	1.11
4463	Guaranteed	——	14.	15.	——
	Found	——	13.51	13.85	——
4518	Guaranteed	1.65	8.	9.	2.
	Found	1.63	7.93	9.97	2.40
4095	Guaranteed	.82	8.	9.	4.
	Found	1.04	8.68	9.78	4.30
4317	Guaranteed	.82	9.	10.	7.
	Found	.91	9.71	10.83	7.62

ANALYSES OF SAMPLES OF FERTILIZERS

NAME AND ADDRESS OF MANUFACTURER OR JOBBER.	Brand or trade name.	Locality where sample was taken.	Number.
American Agricultural Chem. Co., The, New York	Special Potash Mixture	Collins	3357
American Agricultural Chem. Co., The, New York	Superior Alkaline Bone	Stafford	4471
American Agricultural Chem. Co., The, New York	Thomas Phosphate Powder (Basic Slag)	Deposit	4119
American Agricultural Chem. Co., The, New York	12% Acid Phosphate	Eagle Bridge	4067
American Agricultural Chem. Co., The, New York	12% Acid Phosphate	Sherburne	4125
American Agricultural Chem. Co., The, New York	Wheeler's Corn Fertilizer	Locust Valley	3564
American Agricultural Chem. Co., The, New York	Wheeler's Fruit and Grain Grower	Afton	4366
American Agricultural Chem. Co., The, New York	Wheeler's High Grade Phosphate and Potash	Delanson	3346
American Agricultural Chem. Co., The, New York	Wheeler's Peerless Acid Phosphate	Holcomb	4513
American Agricultural Chem. Co., The, New York	Wheeler's Potato Manure	Freeport	3557
American Agricultural Chem. Co., The, New York	Wheeler's Royal Wheat Grower	Holcomb	4514
American Agricultural Chem. Co., The, New York	Wheeler's Superior Truck	South Dayton	4275
American Agricultural Chem. Co., The, New York	Wheeler's Unammoniated Wheat Grower	Weedsport	4023
American Agricultural Chem. Co., The, New York	Wheeler's Wheat and Clover	Cherry Valley	3337
American Agricultural Chem. Co., The, New York	Williams & Clark's Americus Fertilizer	Milton	3607
American Agricultural Chem. Co., The, New York	Williams & Clark's Americus High Grade Special Fertilizer	White Plains	3872

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid. Available.	Phosphoric acid. Total.	Potash.
3357	Guaranteed	.82	9.	10.	7.
	Found	1.16	8.71	10.04	5.91
4471	Guaranteed	——	10.	11.	5.
	Found	——	10.59	10.85	5.12
4119	Guaranteed	——	——	17.	——
	Found	——	——	18.22	——
4067	Guaranteed	——	12.	13.	——
	Found	——	12.24	12.92	——
4125	Guaranteed	——	12.	13.	——
	Found	——	12.50	13.68	——
3564	Guaranteed	1.65	8.	9.	2.
	Found	1.92	8.24	9.32	2.40
4366	Guaranteed	——	10.	11.	8.
	Found	——	10.57	11.01	8.34
3346	Guaranteed	——	12.	13.	5.
	Found	——	12.32	13.	5.34
4513	Guaranteed	——	14.	15.	——
	Found	——	12.95	13.53	——
3557	Guaranteed	2.06	8.	9.	3.
	Found	2.11	8.55	9.87	3.
4514	Guaranteed	.82	8.	9.	2.
	Found	.95	8.05	8.94	2.24
4275	Guaranteed	3.29	8.	9.	7.
	Found	2.09	8.44	9.72	5.46
4023	Guaranteed	——	12.	13.	——
	Found	——	13.12	14.10	——
3337	Guaranteed	——	11.	12.	2.
	Found	——	11.99	12.73	1.89
3607	Guaranteed	1.65	8.	——	10.
	Found	1.70	8.51	9.75	10.86
3872	Guaranteed	3.29	8.	9.	7.
	Found	3.19	8.66	11.08	7.60

ANALYSES OF SAMPLES OF FERTILIZERS

Name and Address of Manufacturer or Jobber.	Brand or trade name.	Locality where sample was taken.	Number.
American Agricultural Chem. Co., The, New York	Williams & Clark's "B" Fertilizer	Trumansburg	4408
American Agricultural Chem. Co., The, New York	Williams & Clark's Chesterfield Manure	Milton	3609
American Agricultural Chem. Co., The, New York	Williams & Clark's Clark's Root Manure	Boonville	3699
American Agricultural Chem. Co., The, New York	Williams & Clark's Defiance Phosphate	Apalachin	4419
American Agricultural Chem. Co., The, New York	Williams & Clark's Elk Brand	Berlin	4060
American Agricultural Chem. Co., The, New York	Williams & Clark's Fruit Tree Invigorator	Sodus	3701
American Agricultural Chem. Co., The, New York	Williams & Clark's Good Grower	Altamont	3348
American Agricultural Chem. Co., The, New York	Williams & Clark's Great Planet Manure	Berlin	4058
American Agricultural Chem. Co., The, New York	Williams & Clark's Mammoth Oak Phosphate	Apalachin	4418
American Agricultural Chem. Co., The, New York	Williams & Clark's Matchless Fertilizer	Berlin	4059
American Agricultural Chem. Co., The, New York	Williams & Clark's Meadow Queen Fertilizer	Pawling	3855
American Agricultural Chem. Co., The, New York	Williams & Clark's Panther Phosphate	Pawling	3854
American Agricultural Chem. Co., The, New York	Williams & Clark's Potash and Fish	Dolgeville	4222
American Agricultural Chem. Co., The, New York	Williams & Clark's Prolific Fertilizer	Berlin	4061
American Agricultural Chem. Co., The, New York	Williams & Clark's Royal Phosphate	Fonda	3688
American Agricultural Chem. Co., The, New York	Williams & Clark's Springfall Fertilizer	Fonda	3689
American Agricultural Chem. Co., The, New York	Williams & Clark's Sterling Plant Food	Sennett	4432

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid. Available.	Phosphoric acid. Total.	Potash.
4408	Guaranteed Found	.82 1.09	8. 8.91	9. 9.65	4. 3.98
3609	Guaranteed Found	2.47 2.58	6. 6.71	—— 8.13	5. 5.78
3699	Guaranteed Found	.82 1.09	9. 9.53	10. 10.83	7. 7.64
4419	Guaranteed Found	—— ——	12. 12.94	13. 13.46	5. 5.06
4060	Guaranteed Found	.82 1.01	8. 8.13	9. 9.01	4. 4.28
3701	Guaranteed Found	—— ——	10. 10.82	11. 11.07	8. 8.50
3348	Guaranteed Found	1.23 1.34	6. 6.59	7. 7.79	5. 5.86
4058	Guaranteed Found	3.29 3.43	8. 8.74	9. 9.82	7. 7.14
4418	Guaranteed Found	2.47 2.70	6. 6.52	7. 7.66	10. 10.56
4059	Guaranteed Found	1.65 1.61	8. 8.74	9. 9.89	2. 2.40
3855	Guaranteed Found	2.47 2.52	9. 10.	10. 11.52	2. 2.30
3854	Guaranteed Found	1.65 1.53	5. 5.57	6. 6.43	10. 9.90
4222	Guaranteed Found	2.47 2.57	4. 4.47	5. 5.21	4. 4.02
4061	Guaranteed Found	.82 .97	7. 7.23	8. 9.53	1. 1.32
3688	Guaranteed Found	1.03 1.12	8. 8.78	9. 10.24	2. 2.56
3689	Guaranteed Found	2.06 2.05	8. 8.68	9. 10.90	3. 3.80
4432	Guaranteed Found	2. 2.31	8. 7.34	9. 10.32	1.50 1.80

ANALYSES OF SAMPLES OF FERTILIZERS

Name and Address of Manufacturer or Jobber.	Brand or trade name.	Locality where sample was taken.	Number.
American Agricultural Chem. Co., The, New York	Williams & Clark's Triumph Phosphate	Berlin	4062
American Agricultural Chem. Co., The, New York	Zell's Dissolved Phosphate	Beaver Dams	4732
American Agricultural Chem. Co., The, New York	Zell's Economizer Phosphate	Interlaken	4708
American Agricultural Chem. Co., The, New York	Zell's Electric Phosphate	Interlaken	4706
American Agricultural Chem. Co., The, New York	Zell's Fruit Tree Invigorator	Brockport	4000
American Agricultural Chem. Co., The, New York	Zell's General Crop Fertilizer	Gates	3999
American Agricultural Chem. Co., The, New York	Zell's High Grade Bone and Potash	Interlaken	4707
American Agricultural Chem. Co., The, New York	Zell's High Grade Wheat and Corn Manure	Sodus	3704
American Agricultural Chem. Co., The, New York	Zell's Special Potato and Cabbage Manure	Sodus	3703
American Fertilizing Co., Baltimore, Md.	American Champion Grain Grower	North Tonawanda	4308
American Fertilizing Co., Baltimore, Md.	American Eagle Crop Grower	Sodus	3733
American Fertilizing Co., Baltimore, Md.	American Excelsior Guano	North Collins	4251
American Fertilizing Co., Baltimore, Md.	American Gilt Edge Truck Manure	North Collins	4255
American Fertilizing Co., Baltimore, Md.	American Potato & Vegetable Compound	North Collins	4254
American Fertilizing Co., Baltimore, Md.	American Prize Truck Guano	North Collins	4256
American Fertilizing Co., Baltimore, Md.	American Standard Crop Compound	Batavia	3485
American Fertilizing Co., Baltimore, Md.	Ammoniated Bone Compound	East Syracuse	4379

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric Acid. Available.	Phosphoric Acid. Total.	Potash.
4062	Guaranteed Found	—— ——	10. 10.79	11. 11.63	2. 2.10
4732	Guaranteed Found	—— ——	14. 14.99	15. 15.38	—— ——
4708	Guaranteed Found	.82 1.03	8. 8.23	9. 8.91	2. 2.60
4706	Guaranteed Found	—— ——	10. 10.17	11. 11.29	2. 2.20
4000	Guaranteed Found	—— ——	10. 10.11	11. 10.39	8. 7.89
3999	Guaranteed Found	.82 .91	8. 8.43	9. 9.45	4. 4.34
4707	Guaranteed Found	—— ——	12. 11.79	13. 12.29	5. 4.98
3704	Guaranteed Found	1.65 1.75	10. 10.07	11. 11.45	4. 4.18
3703	Guaranteed Found	.82 1.14	9. 8.68	10. 9.62	7. 6.50
4308	Guaranteed Found	.82 .91	8. 7.97	9. 11.65	4. 4.10
3733	Guaranteed Found	1.65 1.68	8. 8.52	9. 10.20	2. 2.54
4251	Guaranteed Found	1.65 1.69	8. 7.62	9. 10.39	5. 5.70
4255	Guaranteed Found	3.29 2.91	7. 6.85	8. 8.47	8. 7.52
4254	Guaranteed Found	3.29 3.35	6. 5.95	7. 8.15	10. 10.74
4256	Guaranteed Found	1.65 1.68	8. 7.53	9. 9.45	10. 11.56
3485	Guaranteed Found	—— ——	10. 9.32	11. 11.50	8. 8.40
4379	Guaranteed Found	.82 .85	8. 8.68	9. 10.62	2. 2.60

ANALYSES OF SAMPLES OF FERTILIZERS

Name and Address of Manufacturer or Jobber.	Brand or trade name.	Locality where sample was taken.	Number.
American Fertilizing Co., Baltimore, Md.	Dissolved Bone and Potash	Hunt	4040
American Fertilizing Co., Baltimore, Md.	Double Extra Bone and Potash	Perry	4465
American Fertilizing Co., Baltimore, Md.	High Grade Acid Phosphate	Perry	4466
American Fertilizing Co., Baltimore, Md.	Pure Raw Bone	South Dayton	4272
American Fertilizing Co., Baltimore, Md.	10% Tankage	South Dayton	4273
Armour Fertilizer Works, Baltimore, Md.	Armour's All Soluble Fertilizer	Cincinnatus	3912
Armour Fertilizer Works, Baltimore, Md.	Armour's Ammoniated Bone with Potash	Jamestown	3272
Armour Fertilizer Works, Baltimore, Md.	Armour's Banner Brand Fertilizer	Bergen	3476
Armour Fertilizer Works, Baltimore, Md.	Armour's Bean and Farm Fertilizer	Marcellus	3517
Armour Fertilizer Works, Baltimore, Md.	Armour's Bone, Blood and Potash	Hempstead	3555
Armour Fertilizer Works, Baltimore, Md.	Armour's Bone Meal Fertilizer	Newark	4013
Armour Fertilizer Works, Baltimore, Md.	Armour's Cauliflower, Celery and Potato Mixture	Aquebogue	3596
Armour Fertilizer Works, Baltimore, Md.	Armour's Connecticut Valley Tobacco Grower Fertilizer	Corning	4497
Armour Fertilizer Works, Baltimore, Md.	Armour's Crop Grower Fertilizer	Attica	3495
Armour Fertilizer Works, Baltimore, Md.	Armour's Dried Blood	White Plains	3871
Armour Fertilizer Works, Baltimore, Md.	Armour's Fish & Potash	Aquebogue	3597

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid.		Potash.
			Available.	Total.	
4040	Guaranteed Found	—— ——	10. 10.52	11. 11.74	2. 2.12
4465	Guaranteed Found	—— ——	12. 12.63	13. 14.47	5. 5.38
4466	Guaranteed Found	—— ——	14. 15.54	15. 15.88	—— ——
4272	Guaranteed Found	3.70 3.87	—— ——	20.60 21.32	—— ——
4273	Guaranteed Found	8.23 8.43	—— ——	—— 8.62	—— ——
3912	Guaranteed Found	2.87 2.87	8. 8.61	8.50 10.29	4. 5.12
3272	Guaranteed Found	2.47 2.36	6. 6.13	6.50 7.19	2. 2.56
3476	Guaranteed Found	—— ——	10. 9.71	10.50 10.17	8. 7.48
3517	Guaranteed Found	—— ——	8. 8.61	8.50 9.37	4. 4.12
3555	Guaranteed Found	4.11 3.39	8. 8.98	8.50 9.54	7. 6.79
4013	Guaranteed Found	2.47 2.64	—— ——	22.50 24.06	—— ——
3596	Guaranteed Found	4.93 4.46	8. 8.47	8.50 9.37	5. 5.64
4497	Guaranteed Found	4.52 4.51	4. 3.81	4.50 3.97	5.50 6.80
3495	Guaranteed Found	.82 .85	8. 8.22	8.50 8.84	2. 2.16
3871	Guaranteed Found	13.18 13.30	—— ——	—— ——	—— ——
3597	Guaranteed Found	2.47 2.77	5. 5.54	5.50 6.46	3. 3.50

ANALYSES OF SAMPLES OF FERTILIZERS

NAME AND ADDRESS OF MANUFACTURER OR JOBBER.	Brand or trade name.	Locality where sample was taken.	Number.
Armour Fertilizer Works, Baltimore, Md.	Armour's Fruit & Root Crop Special	Hempstead	3554
Armour Fertilizer Works, Baltimore, Md.	Armour's Grain Grower	East Aurora	3257
Armour Fertilizer Works, Baltimore, Md.	Armour's High Grade Potato	East Aurora	3256
Armour Fertilizer Works, Baltimore, Md.	Armour's Long Island Trucker Fertilizer	Wayland	4507
Armour Fertilizer Works, Baltimore, Md.	Armour's Manure Substitute Fertilizer	Wayland	4506
Armour Fertilizer Works, Baltimore, Md.	Armour's Phosphate and Potash	Interlaken	4709
Armour Fertilizer Works, Baltimore, Md.	Armour's Phosphate and Potash No. 1 Fertilizer	Le Roy	3956
Armour Fertilizer Works, Baltimore, Md.	Armour's Potato & Grain Special Fertilizer	Eden Center	3363
Armour Fertilizer Works, Baltimore, Md.	Armour's Potato Special	Jamestown	3270
Armour Fertilizer Works, Baltimore, Md.	Armour's Potato Special Fertilizer	Utica	3663
Armour Fertilizer Works, Baltimore, Md.	Armour's Raw Bone Meal Fertilizer	Williamson	3452
Armour Fertilizer Works, Baltimore, Md.	Armour's Special Potato Grower Fertilizer	Sherburne	4121
Armour Fertilizer Works, Baltimore, Md.	Armour's Star Phosphate Fertilizer	Williamson	3454
Armour Fertilizer Works, Baltimore, Md.	Armour's Star Phosphate Fertilizer	Yorktown	3863
Armour Fertilizer Works, Baltimore, Md.	Armour's Star Phosphate Fertilizer	Rochester	3997
Armour Fertilizer Works, Baltimore, Md.	Armour's Truckers Special	East Aurora	3255
Armour Fertilizer Works, Baltimore, Md.	Armour's Truckers Special	Williamson	3451

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid. Available.	Phosphoric acid. Total.	Potash.
3554	Guaranteed Found	1.65 1.66	8. 8.32	8.50 8.76	5. 5.24
3257	Guaranteed Found	1.65 1.68	8. 7.90	8.50 9.31	2. 1.98
3256	Guaranteed Found	1.65 1.64	8. 8.15	8.50 8.85	10. 10.07
4507	Guaranteed Found	3.29 3.34	5. 5.85	5.50 6.87	6. 5.73
4506	Guaranteed Found	3.29 3.30	6. 9.17	6.50 10.13	4. 5.08
4709	Guaranteed Found	—— ——	12. 12.05	12.50 12.27	5. 5.60
3956	Guaranteed Found	—— ——	10. 10.35	10.50 10.75	2. 3.65
3363	Guaranteed Found	.82 .87	9. 9.57	9.5 10.41	7. 6.92
3270	Guaranteed Found	2.06 1.97	6. 5.97	6.50 6.83	6. 6.16
3663	Guaranteed Found	2.05 2.06	6. 6.05	6.50 6.95	6. 6.44
3452	Guaranteed Found	3.70 4.18	—— ——	22. 22.36	—— ——
4121	Guaranteed Found	3.29 2.94	8. 9.09	8.50 10.69	7. 7.92
3454	Guaranteed Found	—— ——	14. 14.24	14.50 15.06	—— ——
3863	Guaranteed Found	—— ——	14. 14.66	14.60 15.64	—— ——
3997	Guaranteed Found	—— ——	14. 14.57	14.50 14.91	—— ——
3255	Guaranteed Found	3.29 3.29	6. 6.30	6.50 7.18	10. 9.94
3451	Guaranteed Found	3.29 3.27	6. 6.35	6.50 7.51	10. 10.52

ANALYSES OF SAMPLES OF FERTILIZERS

Name and Address of Manufacturer or Jobber.	Brand or trade name.	Locality where sample was taken.	Number.
Armour Fertilizer Works, Baltimore, Md.	Armour's Wheat and Clover Fertilizer	Le Roy	3957
Armour Fertilizer Works, Baltimore, Md.	Armour's Wheat, Corn and Oat Special	Utica	3662
Armour Fertilizer Works, Baltimore, Md.	Armour's York State Special	East Aurora	3258
Armour Fertilizer Works, Baltimore, Md.	Basic Slag	Mount Kisco	3870
Armour Fertilizer Works, Baltimore, Md.	Dried Blood	Kings Park	3563
Armour Fertilizer Works, Baltimore, Md.	Dried Blood	Rochester	3994
Armour Fertilizer Works, Baltimore, Md.	Genuine German Kainit	Fairport	3982
Armour Fertilizer Works, Baltimore, Md.	Ground Tankage	Fairport	3983
Armour Fertilizer Works, Baltimore, Md.	Muriate of Potash	Castorland	2928
Armour Fertilizer Works, Baltimore, Md.	Muriate of Potash	Williamson	3453
Armour Fertilizer Works, Baltimore, Md.	Muriate of Potash	Yorktown	3864
Armour Fertilizer Works, Baltimore, Md.	Nitrate of Soda	Hempstead	3556
Armour Fertilizer Works, Baltimore, Md.	Nitrate of Soda	Yorktown	3865
Armour Fertilizer Works, Baltimore, Md.	Pure Ground Fish	Laurel	4160
Armour Fertilizer Works, Baltimore, Md.	Sulphate of Potash	Hornell	4047
Atlantic Fertilizer Co., Baltimore, Md.	Atlantic Arrow Brand Special	Guilford	4376
Atlantic Fertilizer Co., Baltimore, Md.	Atlantic G. G. G. Golden Grain Grower	Guilford	4377

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid.		Potash.
			Available.	Total.	
3957	Guaranteed	——	10.	10.50	5.
	Found	——	10.30	10.64	4.68
3662	Guaranteed	.82	7.	7.50	1.
	Found	1.08	7.22	9.32	1.36
3258	Guaranteed	.82	8.	8.50	4.
	Found	.86	8.42	9.26	4.18
3870	Guaranteed	——	——	17.	——
	Found	——	——	17.85	——
3563	Guaranteed	9.87	——	——	——
	Found	12.44	——	——	——
3994	Guaranteed	12.	——	——	——
	Found	12.78	——	——	——
3982	Guaranteed	——	——	——	12.
	Found	——	——	——	13.04
3983	Guaranteed	4.11	——	16.	——
	Found	3.80	——	15.86	——
2928	Guaranteed	——	——	——	48.
	Found	——	——	——	51.42
3453	Guaranteed	——	——	——	48.
	Found	——	——	——	51.18
3864	Guaranteed	——	——	——	48.
	Found	——	——	——	50.34
3556	Guaranteed	14.81	——	——	——
	Found	15.62	——	——	——
3865	Guaranteed	14.81	——	——	——
	Found	15.74	——	——	——
4160	Guaranteed	8.22	——	6.87	——
	Found	9.00	——	7.34	——
4047	Guaranteed	——	——	——	48.
	Found	——	——	——	50.40
4376	Guaranteed	.82	8.	——	4.
	Found	.94	8.09	8.82	4.22
4377	Guaranteed	1.65	9.	——	4.
	Found	1.62	9.16	9.48	4.28

ANALYSES OF SAMPLES OF FERTILIZERS

NAME AND ADDRESS OF MANUFACTURER OR JOBBER.	Brand or trade name.	Locality where sample was taken.	Number.
Atlantic Fertilizer Co., Baltimore, Md.	Atlantic Standard Compound	Guilford	4374
Atlantic Fertilizer Co., Baltimore, Md.	Atlantic XX Special Compound for Potatoes	Guilford	4375
Baugh & Sons Co., Baltimore, Md.	Baugh's Animal Base and Potash Compound for All Crops	Middleville	3691
Baugh & Sons Co., Baltimore, Md.	Baugh's Balanced Plant Food	Middleport	4301
Baugh & Sons Co., Baltimore, Md.	Baugh's Commercial Super-Phosphate for General Use	Sodus	3709
Baugh & Sons Co., Baltimore, Md.	Baugh's Complete Animal Base Fertilizer	Sodus	3708
Baugh & Sons Co., Baltimore, Md.	Baugh's Excelsior Guano	Sodus	3717
Baugh & Sons Co., Baltimore, Md.	Baugh's Fish, Bone and Potash	Groton	3946
Baugh & Sons Co., Baltimore, Md.	Baugh's General Crop Grower for All Crops	Middleville	3692
Baugh & Sons Co., Baltimore, Md.	Baugh's Grand Rapid High Grade Guano	Stanley	4491
Baugh & Sons Co., Baltimore, Md.	Baugh's Half Century Perfection Brand	Middleport	4302
Baugh & Sons Co., Baltimore, Md.	Baugh's High Grade Acid Phosphate	Binghamton	4132
Baugh & Sons Co., Baltimore, Md.	Baugh's High Grade Cotton and Truck Guano	Ithaca	4403
Baugh & Sons Co., Baltimore, Md.	Baugh's High Grade Potato Grower	Middleville	3694
Baugh & Sons Co., Baltimore, Md.	Baugh's Peninsula Grain Producer	Truxton	3936
Baugh & Sons Co., Baltimore, Md.	Baugh's Peruvian Guano	Clyde	4019

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen	Phosphoric acid. Available.	Phosphoric acid. Total.	Potash.
4374	Guaranteed Found	1.65 1.65	8. 7.48	——— 8.08	2. 2.42
4375	Guaranteed Found	1.65 1.62	8. 8.42	——— 8.78	10. 9.34
3691	Guaranteed Found	1.65 1.76	8. 8.77	——— 11.47	2. 2.40
4301	Guaranteed Found	1.65 1.74	10.50 11.89	——— 13.27	7. 7.52
3709	Guaranteed Found	1.65 1.84	8. 9.27	——— 9.89	10. 10.04
3708	Guaranteed Found	1.65 1.82	8. 8.84	——— 9.58	5. 3.89
3717	Guaranteed Found	.82 1.00	8. 8.62	——— 9.36	4. 4.56
3946	Guaranteed Found	3.30 2.52	8. 9.02	——— 9.74	4. 4.32
3692	Guaranteed Found	.82 .97	8. 9.45	——— 11.83	1. 1.43
4491	Guaranteed Found	2.47 2.67	8. 9.53	——— 10.93	3. 3.52
4302	Guaranteed Found	3.30 3.40	8. 9.20	8. 10.98	7. 6.98
4132	Guaranteed Found	——— ———	14. 17.12	——— 17.20	——— ———
4403	Guaranteed Found	1.65 1.71	10. 10.71	——— 11.21	2. 2.12
3694	Guaranteed Found	3.30 3.25	8. 9.75	——— 11.31	10. 10.51
3936	Guaranteed Found	.82 1.00	9. 9.35	——— 10.15	3. 3.46
4019	Guaranteed Found	4.12 4.25	6. 6.53	——— 7.03	7. 7.46

ANALYSES OF SAMPLES OF FERTILIZERS

NAME AND ADDRESS OF MANUFACTURER OR JOBBER.	Brand or trade name.	Locality where sample was taken.	Number.
Baugh & Sons Co., Baltimore, Md.	Baugh's Phosphate and Potash	Sodus	3716
Baugh & Sons Co., Baltimore, Md.	Baugh's Potato and Truck Special for All Truck Crops	Chittenango Stat'n	4360
Baugh & Sons Co., Baltimore, Md.	Baugh's Pure Bone and Muriate Potash Mixture	Chenango Bridge	4137
Baugh & Sons Co., Baltimore, Md.	Baugh's Pure Dissolved Animal Bone	Sodus	3714
Baugh & Sons Co., Baltimore, Md.	Baugh's Raw Bone Meal	Middleville	3693
Baugh & Sons Co., Baltimore, Md.	Baugh's 16% Acid Phosphate	Sodus	3711
Baugh & Sons Co., Baltimore, Md.	Baugh's Soluble Alkaline Super-Phosphate	Taylor	3928
Baugh & Sons Co., Baltimore, Md.	Baugh's Special Potato Manure	Binghamton	4133
Baugh & Sons Co., Baltimore, Md.	Baugh's 12 & 5 Phosphate and Potash	Ithaca	4404
Baugh & Sons Co., Baltimore, Md.	Baugh's Wheat Fertilizer for Wheat and Grass	Ithaca	4402
Baugh & Sons Co., Baltimore, Md.	Fine Ground Tankage	Oneida	4381
Baugh & Sons Co., Baltimore, Md.	Genuine German Kainit	Chittenango Sta'n	4359
Baugh & Sons Co., Baltimore, Md.	Muriate of Potash	Sodus	3712
The Berg Co., Philadelphia, Pa.	Berg's High Grade Potato Manure	Ossining	4557
The Berg Co., Philadelphia, Pa.	Berg's Raw Bone Fine	Ossining	4558
The Berg Co., Philadelphia, Pa.	Berg's Standard Bone Manure	Ossining	4556

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid. Available.	Phosphoric acid. Total.	Potash.
3716	Guaranteed	——	10.	——	8.
	Found	——	11.91	12.79	7.17
4360	Guaranteed	2.88	7.	——	7.
	Found	2.94	8.69	10.55	6.81
4137	Guaranteed	2.47	——	15.	5.
	Found	2.77	10.20	14.43	6.62
3714	Guaranteed	2.06	13.	——	——
	Found	1.90	16.17	16.67	——
3693	Guaranteed	3.70	——	21.50	——
	Found	3.65	——	22.58	——
3711	Guaranteed	——	16.	——	——
	Found	——	17.62	18.08	——
3928	Guaranteed	——	10.	——	2.
	Found	——	11.06	12.60	2.10
4133	Guaranteed	1.65	5.	——	10.
	Found	1.87	6.21	6.63	10.64
4404	Guaranteed	——	12.	——	5.
	Found	——	12.41	12.57	5.30
4402	Guaranteed	1.65	8.	——	2.
	Found	1.74	8.76	9.66	2.36
4381	Guaranteed	7.40	——	5.	——
	Found	7.31	——	10.35	——
4359	Guaranteed	——	——	——	12.
	Found	——	——	——	12.08
3712	Guaranteed	——	——	——	48.
	Found	——	——	——	49.40
4557	Guaranteed	3.	8.	11.	10.
	Found	1.75	8.84	10.10	10.84
4558	Guaranteed	3.	——	22.	——
	Found	3.76	——	22.08	——
4556	Guaranteed	3.	8.	11.	6.
	Found	1.57	11.47	12.22	5.90

ANALYSES OF SAMPLES OF FERTILIZERS

Name and Address of Manufacturer or Jobber.	Brand or trade name.	Locality where sample was taken.	Number.
The Berg Co., Philadelphia, Pa.	Berg's Truckers Joy	Ossining	4555
Berkshire Fertilizer Co., Bridgeport, Conn.	Berkshire Complete Fertilizer	Orient	4179
Berkshire Fertilizer Co., Bridgeport, Conn.	Berkshire Grass Special	Athens	3894
Bowker Fertilizer Co., New York, N. Y.	Bowker's Ammoniated Dissolved Bone	East Aurora	3266
Bowker Fertilizer Co., New York, N. Y.	Bowker's Ammoniated Food for Flowers	Buffalo	4333
Bowker Fertilizer Co., New York, N. Y.	Bowker's B. B. & P. Compound	Calverton	4154
Bowker Fertilizer Co., New York, N. Y.	Bowker's Best Grain Fertilizer	Webster	4006
Bowker Fertilizer Co., New York, N. Y.	Bowker's Corn and Grain Grower	Lyons Falls	2920
Bowker Fertilizer Co., New York, N. Y.	Bowker's Corn & Wheat Guano	Batavia	3488
Bowker Fertilizer Co., New York, N. Y.	Bowker's Dissolved Phosphate	Cincinnatus	3906
Bowker Fertilizer Co., New York, N. Y.	Bowker's Early Potato Manure	Deerfield	3660
Bowker Fertilizer Co., New York, N. Y.	Bowker's Empire State Phosphate and Potash	North Collins	3289
Bowker Fertilizer Co., New York, N. Y.	Bowker's Farm and Garden Phosphate	Huntington	3580
Bowker Fertilizer Co., New York, N. Y.	Bowker's Fresh Ground Bone	Huntington	3581
Bowker Fertilizer Co., New York, N. Y.	Bowker's Golden Harvest Fertilizer	Cherry Valley	3325
Bowker Fertilizer Co., New York, N. Y.	Bowker's Grain and Grass Fertilizer	Calverton	4155
Bowker Fertilizer Co., New York, N. Y.	Bowker's Hill and Drill Phosphate	Deerfield	3658

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric Acid.		Potash.
			Available.	Total.	
4555	Guaranteed Found	3.70 2.50	8. 7.32	11. 8.13	8. 12.74
4179	Guaranteed Found	2.5 3.22	8. 8.32	9. 8.68	6. 6.08
3894	Guaranteed Found	5. 5.16	4. 5.11	5. 5.57	2. 3.37
3266	Guaranteed Found	1.65 1.64	8. 7.57	9. 9.14	2. 2.22
4333	Guaranteed Found	2.47 2.58	6. 7.58	—— 8.89	2. 3.23
4154	Guaranteed Found	4.11 3.23	7. 9.26	8. 11.12	7. 6.74
4006	Guaranteed Found	1.23 1.31	10. 9.87	11. 11.34	6. 5.41
2920	Guaranteed Found	.82 1.15	8. 7.25	9. 8.67	4. 4.18
3488	Guaranteed Found	1.65 1.74	8. 8.06	9. 9.82	4. 4.14
3906	Guaranteed Found	—— ——	11. 13.11	12. 14.45	—— ——
3660	Guaranteed Found	3.29 3.26	7. 7.83	8. 9.35	7. 6.61
3289	Guaranteed Found	—— ——	8. 8.18	9. 8.72	3. 3.14
3580	Guaranteed Found	1.65 1.73	8. 8.18	9. 9.50	2. 3.28
3581	Guaranteed Found	2.47 2.14	—— ——	22.88 24.95	—— ——
3325	Guaranteed Found	—— ——	12. 12.72	13. 13.22	5. 5.06
4155	Guaranteed Found	2.47 2.56	8. 7.99	9. 9.61	4. 4.26
3658	Guaranteed Found	2.47 2.47	9. 9.85	10. 11.25	2. 2.50

ANALYSES OF SAMPLES OF FERTILIZERS

Name and Address of Manufacturer or Jobber.	Brand or trade name.	Locality where sample was taken.	Number.
Bowker Fertilizer Co., New York, N. Y.	Bowker's Hop and Potato Phosphate with Extra Potash	Lyons Falls	2921
Bowker Fertilizer Co., New York, N. Y.	Bowker's Lawn and Garden Dressing	Binghamton	4387
Bowker Fertilizer Co., New York, N. Y.	Bowker's Market Garden Fertilizer	Deerfield	3657
Bowker Fertilizer Co., New York, N. Y.	Bowker's Potash Fertilizer	Buffalo	3376
Bowker Fertilizer Co., New York, N. Y.	Bowker's Potash or Staple Phosphate	Falconer	3283
Bowker Fertilizer Co., New York, N. Y.	Bowker's Potato and Vegetable Fertilizer	Deerfield	3659
Bowker Fertilizer Co., New York, N. Y.	Bowker's Six Per Cent Potato Fertilizer	Pine Island	3622
Bowker Fertilizer Co., New York, N. Y.	Bowker's Soluble Phosphate	Calverton	4156
Bowker Fertilizer Co., New York, N. Y.	Bowker's Special Crop Grower	East Aurora	3265
Bowker Fertilizer Co., New York, N. Y.	Bowker's Sure Crop Phosphate	Minoa	3536
Bowker Fertilizer Co., New York, N. Y.	Bowker's Ten and Eight	Skaneateles	3507
Bowker Fertilizer Co., New York, N. Y.	Bowker's Ten Per Cent Manure	Cherry Valley	3326
Bowker Fertilizer Co., New York, N. Y.	Muriate of Potash	Greenwich	4083
Bowker Fertilizer Co., New York, N. Y.	Nitrate of Soda	North Collins	3290
Bowker Fertilizer Co., New York, N. Y.	Stockbridge Special Complete Manure for Corn and All Grain Crops	Oxford	4110
Bowker Fertilizer Co., New York, N. Y.	Stockbridge Special Complete Manure for Potatoes and Vegetables	Batavia	3486

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid. Available.	Phosphoric acid. Total.	Potash.
2921	Guaranteed Found	.82 1.10	8. 7.59	9. 8.70	5. 5.10
4387	Guaranteed Found	3.29 3.24	4. 6.28	8. 9.77	5. 5.18
3657	Guaranteed Found	2.47 2.50	6. 6.44	7. 7.98	10. 9.67
3376	Guaranteed Found	.82 .93	6. 6.10	7. 7.04	2. 2.76
3283	Guaranteed Found	.82 .96	8. 8.59	9. 9.47	3. 2.42
3659	Guaranteed Found	2.47 2.56	8. 8.29	9. 9.81	4. 4.06
3622	Guaranteed Found	.82 1.15	6. 6.47	7. 8.23	6. 6.26
4156	Guaranteed Found	—— ——	14. 14.59	15. 16.11	—— ——
3265	Guaranteed Found	1.65 1.74	8. 8.10	9. 9.42	10. 9.88
3536	Guaranteed Found	.82 .90	9. 9.81	10. 11.19	2. 2.38
3507	Guaranteed Found	—— ——	10. 11.78	11. 12.18	8. 7.49
3326	Guaranteed Found	.82 .87	5. 5.36	6. 6.58	10. 10.42
4083	Gauranteed Found	—— ——	—— ——	—— ——	49. 48.15
3290	Guaranteed Found	15. 15.26	—— ——	—— ——	—— ——
4110	Guaranteed Found	3.29 3.31	10. 10.04	11. 11.56	7. 8.70
3486	Guaranteed Found	3.29 3.24	6. 5.59	7. 7.15	10. 10.04

ANALYSES OF SAMPLES OF FERTILIZERS

Name and Address of Manufacturer or Jobber.	Brand or trade name.	Locality where sample was taken.	Number.
Bowker Fertilizer Co., New York, N. Y.	Stockbridge Special Complete Manure for Seeding Down, Permanent Dressing and Legumes	Nineveh	4398
Bowker Fertilizer Co., New York, N. Y.	Stockbridge Special Complete Manure for Top Dressing and for Forcing	Nineveh	4399
Butts, J. P., Oneonta, N. Y.	Hustler	Oneonta	4215
Butts, J. P., Oneonta, N. Y.	Potato Manure No. 1	Oneonta	4227
Butts, J. P., Oneonta, N. Y.	Standard No. 1	Oneonta	4214
Case & Co., A. H., East Buffalo, N. Y.	Case's Complete Fertilizer No. 1 with Manure Filler	Geneva	4480
Case & Co., A. H., East Buffalo, N. Y.	Excelsior Brand Pulverized Pig Manure	Geneva	4479
Case & Co., A H., East Buffalo, N. Y.	Excelsior Brand Pulverized Sheep Manure	Fairport	3983
Chittenden Co., The E. D., Bridgeport, Conn.	Chittenden's High Grade Potato	Calverton	4157
Chittenden Co., The E. D., Bridgeport, Conn.	Chittenden's Special for Corn, Cabbage and Cauliflower	Riverhead	4195
Clark & Son, O. W., Buffalo, N. Y.	Clark's Velvet Lawn Fertilizer	Buffalo	3387
Clark & Son, O. W., Buffalo, N. Y.	Plant Food	Buffalo	3386
Clay & Son, Stratford, London, Eng.	Clay's Fertilizer	New York	4613
Coe-Mortimer Co., The, New York, N. Y.	Bedford Farmers 4-10-8 Brand	Mount Kisco	3867
Coe-Mortimer Co., The, New York, N. Y.	Bedford Farmers 3-8-6 Brand	Mount Kisco	3866

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid. Available.	Phosphoric acid. Total.	Potash.
4398	Guaranteed	2.47	10.	11.	8.
	Found	2.56	10.65	11.59	8.20
4399	Guaranteed	4.94	4.	5.	6.
	Found	4.16	5.39	6.06	6.44
4215	Guaranteed	.82	8.	9.	4.
	Found	1.05	7.45	9.20	4.68
4227	Guaranteed	2.47	8.	9.	7.
	Found	2.56	8.67	10.03	7.28
4214	Guaranteed	1.23	8.	9.	2.50
	Found	1.57	8.60	10.48	2.80
4480	Guaranteed	1.64	8.	——	4.
	Found	2.18	9.19	9.55	4.30
4479	Guaranteed	1.	1.	——	1.
	Found	2.03	2.52	2.66	1.12
3985	Guaranteed	1.	.87	——	1.
	Found	1.39	.99	1.05	.94
4157	Guaranteed	4.10	8.	9.	7.
	Found	4.09	8.54	9.40	7.16
4195	Guaranteed	4.95	8.	9.	5.
	Found	4.93	8.67	9.65	4.96
3387	Guaranteed	2.	5.	——	3.
	Found	2.79	8.48	9.10	4.21
3386	Guaranteed	3.50	7.	——	6.
	Found	4.21	9.09	10.25	7.94
4613	Guaranteed	4.	1.15	7.20	.10
	Found	4.07	2.92	8.52	.64
3867	Guaranteed	3.29	10.	11.	8.
	Found	3.43	10.41	11.59	8.36
3866	Guaranteed	2.47	8.	9.	6.
	Found	2.57	8.58	9.84	6.74

ANALYSES OF SAMPLES OF FERTILIZERS

NAME AND ADDRESS OF MANUFACTURER OR JOBBER.	Brand or trade name.	Locality where sample was taken.	Number.
Coe-Mortimer Co., The, New York, N. Y.	E. Frank Coe's Celebrated Special Potato Fertilizer	Wrights Station	3843
Coe-Mortimer Co., The, New York, N. Y.	E. Frank Coe's Columbian Corn & Potato Fertilizer	North Collins	3299
Coe-Mortimer Co., The, New York, N. Y.	E. Frank Coe's Double Strength Potato Manure	Cortland	3901
Coe-Mortimer Co., The, New York, N. Y.	E. Frank Coe's Economical Potato Manure	Cherry Valley	3330
Coe-Mortimer Co., The, New York, N. Y.	E. Frank Coe's Empire State Brand	Alabama Center	4472
Coe-Mortimer Co., The, New York, N. Y.	E. Frank Coe's Excelsior Potato Fertilizer	Seneca Falls	4701
Coe-Mortimer Co., The, New York, N. Y.	E. Frank Coe's Extra Special Potato Fertilizer and Fruit Grower	North Collins	3298
Coe-Mortimer Co., The, New York, N. Y.	E. Frank Coe's Famous Prize Brand Grain & Grass Fertilizer	Franklinville	4267
Coe-Mortimer Co., The, New York, N. Y.	E. Frank Coe's Gold Brand Excelsior Guano	Tully	3538
Coe-Mortimer Co., The, New York, N. Y.	E. Frank Coe's Gold Brand Excelsior Guano	Mount Kisco	3868
Coe-Mortimer Co., The, New York, N. Y.	E. Frank Coe's Golden Harvest Fertilizer	Cortland	3902
Coe-Mortimer Co., The, New York, N. Y.	E. Frank Coe's Grain and Vegetable Grower	Tully	3537
Coe-Mortimer Co., The, New York, N. Y.	E. Frank Coe's High Grade Dissolved Phosphate & Potash	Swormville	4320
Coe-Mortimer Co., The, New York, N. Y.	E. Frank Coe's High Grade Soluble Phosphate	Guilford	4369
Coe-Mortimer Co., The, New York, N. Y.	E. Frank Coe's New England Special Fertilizer	Swormville	4319

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid. Available.	Phosphoric acid. Total.	Potash.
3843	Guaranteed Found	1.65 1.70	8. 8.74	9. 9.96	4. 4.38
3299	Guaranteed Found	1.23 1.24	8.5 8.65	9.5 10.17	2.5 3.26
3901	Guaranteed Found	3.70 3.85	7. 8.20	8. 9.	10. 10.46
3330	Guaranteed Found	.82 .83	4. 5.03	5. 6.31	8. 7.73
4472	Guaranteed Found	1.23 1.42	9. 9.73	10. 10.49	6. 7.02
4701	Guaranteed Found	2.47 2.57	7. 7.85	8. 8.75	8. 8.28
3298	Guaranteed Found	1.65 1.71	8. 8.67	9. 10.19	10. 10.56
4267	Guaranteed Found	—— ——	10. 10.57	11. 11.37	2. 2.18
3538	Guaranteed Found	2.47 2.60	8. 8.75	9. 10.53	6. 6.44
3868	Guaranteed Found	2.47 2.65	8. 9.35	9. 10.91	6. 6.64
3902	Guaranteed Found	—— ——	10. 10.03	11. 10.63	8. 8.40
3537	Guaranteed Found	.82 .98	8. 8.94	9. 9.66	7. 6.95
4320	Guaranteed Found	—— ——	8. 8.29	9. 9.09	5. 5.32
4369	Guaranteed Found	—— ——	14. 15.25	15. 16.95	—— ——
4319	Guaranteed Found	.82 1.20	8. 8.47	9. 9.73	3. 3.42

ANALYSES OF SAMPLES OF FERTILIZERS

Name and Address of Manufacturer or Jobber.	Brand or trade name.	Locality where sample was taken.	Number.
Coe-Mortimer Co., The, New York, N. Y.	E. Frank Coe's Red Brand Excelsior Guano for Market Gardening	North Collins	3297
Coe-Mortimer Co., The, New York, N. Y.	E. Frank Coe's Top Dressing Manure	Wrights Station	3842
Coe-Mortimer Co., The, New York, N. Y.	E. Frank Coe's 12% Superphosphate	Cherry Valley	3331
Coe-Mortimer Co., The, New York, N. Y.	E. Frank Coe's Western New Yorker	Tully	3540
Coe-Mortimer Co., The, New York, N. Y.	E. Frank Coe's XXV Ammoniated Phosphate	Dayton	4284
Coe-Mortimer Co., The, New York, N. Y.	Sulphate of Potash	Mount Kisco	3869
Coe-Mortimer Co., The, New York, N. Y.	Thomas Phosphate Powder (Basic Slag Phosphate)	North Collins	3300
Columbia Guano Co., Baltimore, Md.	Colguanco Potato Manure	Canastota	4355
Columbia Guano Co., Baltimore, Md.	Columbia General Crop Manure	Canastota	4354
Columbia Guano Co., Baltimore, Md.	Columbia Grain Special Fertilizer	So. Alabama	4474
Columbia Guano Co., Baltitimore, Md.	Columbia Premium Phosphate & Potash	So. Alabama	4473
Columbia Guano Co., Baltimore, Md.	Columbia Prize Crop Phosphate	Rexville	4049
Columbia Guano Co., Baltimore, Md.	Columbia Special Potato Formula	Canastota	4353
Columbia Guano Co., Baltimore, Md.	Columbia Special Potato Guano	Glens Falls	4088
Columbia Guano Co., Baltimore, Md.	Columbia Truck & Garden Manure	Mineola	3585
Columbia Guano Co., Baltimore, Md.	Columbia 12% Acid Phosphate	Glens Falls	4090

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen	Phosphoric acid. Available.	Phosphoric acid. Total.	Potash.
3297	Guaranteed Found	3.29 3.25	8. 8.50	9. 10.26	7. 7.08
3842	Guaranteed Found	7.41 7.27	6. 6.87	7. 7.77	3. 5.48
3331	Guaranteed Found	—— ——	12. 13.99	13. 14.27	—— ——
3540	Guaranteed Found	.82 .91	8. 8.52	9. 9.44	4. 4.78
4284	Guaranteed Found	.82 1.	8. 8.75	9. 9.97	2. 2.32
3869	Guaranteed Found	—— ——	—— ——	—— ——	48. 49.94
3300	Guaranteed Found	—— ——	15. *——	17. 19.83	—— ——
4355	Guaranteed Found	3.29 2.98	8. 8.02	8.50 9.39	10. 9.87
4354	Guaranteed Found	.82 .84	8. 7.45	8.50 8.48	4. 4.66
4474	Guaranteed Found	.82 .92	8. 8.07	8.50 9.29	2. 2.40
4473	Guaranteed Found	—— ——	10. 10.08	—— 11.36	8. 6.53
4049	Guaranteed Found	—— 3.	8. 8.35	8.50 8.85	5. 5.26
4353	Guaranteed Found	1.65 1.63	8. 8.03	8.50 8.91	10. 11.12
4088	Guaranteed Found	1.65 1.88	5. 6.43	5.5 7.49	10. 9.14
3585	Guaranteed Found	3.29 3.32	8. 8.89	8.50 10.61	7. 7.06
4090	Guaranteed Found	—— ——	14. 15.04	14.50 15.80	—— ——

* No official method for determining available P_2O_5 in this sample.

ANALYSES OF SAMPLES OF FERTILIZERS

Name and Address of Manufacturer or Jobber.	Brand or trade name.	Locality where sample was taken.	Number.
Columbia Guano Co., Baltimore, Md.	Genuine German Kainit	Canastota	4659
Columbia Guano Co., Baltimore, Md.	Nitrate of Soda	Mineola	3586
Cooper's Fertilizer, Peter, New York, N. Y.	Peter Cooper's Pure Bone Dust	Tarrytown	3876
Daniels, Fred, Houghton, N. Y.	Daniels Commonsense Grain and Grass Grower	Machias	4271
Davidge, William M., Brooklyn, N. Y.	Davidge's Concentrated Manure	Rockville Center	3575
Davidge, William M., Brooklyn, N. Y.	Davidge's Special Phosphorus	Rockville Center	3576
Day, Mrs. R. White, Arlington, N. Y.	Pure Bone & Meat Fertiliser	Arlington	3883
Enterprise Guano Co., Baltimore, Md.	Complete Manure for all Crops	West Falls	4285
Enterprise Guano Co., Baltimore, Md.	14% Acid Phosphate	Oneida	4380
Enterprise Guano Co., Baltimore, Md.	Ideal Grain Grower	Barnerville	3323
Enterprise Guano Co., Baltimore, Md.	Phosphate & Potash	Barnerville	3322
Enterprise Guano Co., Baltimore, Md.	Special Potato Grower	Barnerville	3324
Enterprise Guano Co., Baltimore, Md.	Super-phosphate	Barnerville	3321
Enterprise Guano Co., Baltimore, Md.	Vegetable & Potato Guano	West Falls	4288
Fertilizer Materials Supply Co., The, New York, N. Y.	Ground Tankage	New York	4632
Fertilizer Materials Supply Co., The, New York, N. Y.	Muriate of Potash	New York	4633
Fertilizer Materials Supply Co., The, New York, N. Y.	Nitrate of Soda	New York	4634

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid.		Potash.
			Available.	Total.	
4659	Guaranteed	—	—	—	12.
	Found	—	—	—	12.62
3586	Guaranteed	15.	—	—	—
	Found	15.44	—	—	—
3876	Guaranteed	2.05	—	22.88	—
	Found	1.55	—	28.10	—
4271	Guaranteed	—	14.	15.	—
	Found	—	13.69	14.21	—
3575	Guaranteed	1.	—	—	—
	Found	2.29	1.59	2.25	1.10
3576	Guaranteed	—	—	5.	—
	Found	—	—	19.20	—
3883	Guaranteed	3.54	—	21.24	—
	Found	5.56	—	14.04	—
4285	Guaranteed	1.65	8.	—	5.
	Found	1.80	8.65	11.41	5.
4380	Guaranteed	—	14.	—	—
	Found	—	15.44	15.86	—
3323	Guaranteed	.82	8.	—	4.
	Found	.92	7.82	9.10	4.90
3322	Guaranteed	—	10.	—	8.
	Found	—	10.23	10.59	7.43
3324	Guaranteed	.82	4.	—	8.
	Found	.89	4.30	5.34	8.78
3321	Guaranteed	—	12.	—	—
	Found	—	12.75	13.27	—
4288	Guaranteed	1.65	8.	—	10.
	Found	1.64	7.54	9.45	10.04
4632	Guaranteed	6.56	—	9.24	—
	Found	6.46	—	10.14	—
4633	Guaranteed	—	—	—	50.
	Found	—	—	—	50.04
4634	Guaranteed	15.	—	—	—
	Found	15.38	—	—	—

ANALYSES OF SAMPLES OF FERTILIZERS

Name and Address of Manufacturer or Jobber.	Brand or trade name.	Locality where sample was taken.	Number.
Fertilizer Materials Supply Co., The, New York, N. Y.	No. 1 Potato & General Truck Fertilizer	New York	4630
Fertilizer Materials Supply Co., The, New York, N. Y.	No. 2 Potato & Truck Fertilizer	New York	4631
German Kali Works, Baltimore, Md.	Kainit	Montour Falls	4736
German Kali Works, Baltimore, Md.	Muriate of Potash	Aquebogue	3598
German Kali Works, Baltimore, Md.	Muriate of Potash	Charlotte	4454
Giddings, Burt L., Baldwinsville, N. Y.	Burt's Banner	Baldwinsville	4147
Grace & Co., W. R., New York, N. Y.	Nitrate of Soda	New York	4635
Griffith & Boyd Co., Baltimore, Md.	Griffith & Boyd Co.'s Farmers Potato Manure	Seneca Castle	4483
Griffith & Boyd Co., Baltimore, Md.	Griffith & Boyd Co.'s Fish Bone and Potash	Victor	4490
Griffith & Boyd Co., Baltimore, Md.	Griffith & Boyd Co.'s Gilt Edge Crop Guano	Holley	3832
Griffith & Boyd Co., Baltimore, Md.	Griffith & Boyd Co.'s High Grade Acid Phosphate	Victor	4489
Griffith & Boyd Co., Baltimore, Md.	Griffith & Boyd Co.'s Royal Potash Guano	Merrifield	4029
Griffith & Boyd Co., Baltimore, Md.	Griffith & Boyd Co.'s Royal 10 & 8	Holley	3833
Griffith & Boyd Co., Baltimore, Md.	Griffith & Boyd Co.'s Special Grain Grower	Starkey	4510
Griffith & Boyd Co., Baltimore, Md.	Griffith & Boyd Co.'s Vegetable & Tobacco Grower	Seneca Castle	4484
Griffith & Boyd Co., Baltimore, Md.	Griffith & Boyd Co.'s Vegetable Bone	Seneca Castle	4485

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid. Available.	Phosphoric acid. Total.	Potash.
4630	Guaranteed	3.31	8.	——	7.
	Found	3.36	8.57	9.68	6.16
4631	Guaranteed	1.64	7.	——	7.
	Found	3.65	7.01	10.35	7.
4736	Guaranteed	——	——	——	12.
	Found	——	——	——	12.84
3598	Guaranteed	——	——	——	50.
	Found	——	——	——	51.74
4454	Guaranteed	——	——	——	48.
	Found	——	——	——	49.98
4147	Guaranteed	.80	——	8.	4.
	Found	1.30	10.28	10.86	5.78
4635	Guaranteed	15.	——	——	——
	Found	15.22	——	——	——
4483	Guaranteed	.82	8.	9.	9.
	Found	.76	8.59	9.82	7.51
4490	Guaranteed	1.50	7.	8.	3.
	Found	1.19	8.75	9.61	3.02
3832	Guaranteed	1.65	8.	9.	10.
	Found	1.67	8.71	11.33	10.48
4489	Guaranteed	——	14.	15.	——
	Found	——	15.72	16.60	——
4029	Guaranteed	.85	8.	9.	4.
	Found	.84	8.72	9.52	4.26
3833	Guaranteed	——	10.	11.	8.
	Found	——	10.88	13.10	7.59
4510	Guaranteed	——	10.	11.	2.
	Found	——	11.18	13.54	2.76
4484	Guaranteed	3.30	6.	7.	10.
	Found	2.66	7.25	8.56	9.08
4485	Guaranteed	2.50	8.	9.	7.
	Found	1.96	8.12	9.14	7.80

ANALYSES OF SAMPLES OF FERTILIZERS

Name and Address of Manufacturer or Jobber.	Brand or trade name.	Locality where sample was taken.	Number.
Griffith & Boyd Co., Baltimore, Md.	Griffith & Boyd Co.'s XX Potash Manure	Venice Center	4027
Hammond's Slug Shot Works, Fishkill-on-Hudson, N. Y.	Hammond's Sward Food	Fishkill-on-Hudson	3881
Haxstun, R. B., Fort Edward, N. Y.	Haxstun's Bone Meal Fertilizer	Moreau	4094
Health Chemical Co., Yonkers, N. Y.	Dutchess Brand	Yonkers	3862
Health Chemical Co., Yonkers, N. Y.	Hudson Brand	Yonkers	3861
Health Chemical Co., Yonkers, N. Y.	Westchester Brand	Yonkers	3860
Henderson & Co., Peter, New York, N. Y.	Henderson's Blood and Bone Fertilizer	New York	4621
Henderson & Co., Peter, New York, N. Y.	Henderson's Cabbage & Cauliflower Fertilizer	New York	4620
Henderson & Co., Peter, New York, N. Y.	Henderson's Corn Fertilizer	New York	4619
Henderson & Co., Peter, New York, N. Y.	Henderson's Garden Fertilizer	New York	4615
Henderson & Co., Peter, New York, N. Y.	Henderson's Plant Food Tablets	New York	4625
Henderson & Co., Peter, New York, N. Y.	Henderson's Potato Fertilizer	New York	4617
Henderson & Co., Peter, New York, N. Y.	Henderson's Pure Bone	New York	4622
Henderson & Co., Peter, New York, N. Y.	Henderson's Universal Super-Phosphate	New York	4618
Henderson & Co., Peter, New York, N. Y.	The Henderson Lawn Enricher	New York	4616
Hess & Bro., Inc., S. M., Philadelphia, Pa.	Ammoniated Superphosphate	Crown Point C't'r.	4852

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid. Available.	Phosphoric acid. Total.	Potash.
4027	Guaranteed	——	10.	11.	5.
	Found	——	10.95	12.79	4.23
3881	Guaranteed	2.35	4.50	5.50	4.60
	Found	2.40	6.60	6.98	4.43
4094	Guaranteed	3.60	——	24.50	——
	Found	5.14	——	14.54	——
3862	Guaranteed	4.	7.	8.	8.
	Found	4.09	7.90	8.82	8.14
3861	Guaranteed	1.62	7.	8.	8.
	Found	1.78	4.46	6.20	10.02
3860	Guaranteed	.80	6.	7.	6.
	Found	1.44	7.12	8.88	6.44
4621	Guaranteed	4.12	——	17.	——
	Found	4.44	——	18.26	——
4620	Guaranteed	4.11	7.	8.	7.
	Found	4.28	8.39	8.77	6.86
4619	Guaranteed	2.47	10.	11.	5.
	Found	2.68	11.01	12.21	5.68
4615	Guaranteed	4.12	7.	8.	5.
	Found	4.20	7.65	8.47	5.40
4625	Guaranteed	7.	7.	——	7.
	Found	9.02	10.44	10.48	8.08
4617	Guaranteed	3.70	7.	8.	8.
	Found	3.90	7.88	8.86	8.62
4622	Guaranteed	2.47	——	20.	——
	Found	3.34	——	22.93	——
4618	Guaranteed	2.47	8.	9.	4.
	Found	2.56	8.29	9.73	4.48
4616	Guaranteed	2.47	3.50	4.50	2.50
	Found	2.48	4.58	5.60	2.70
4852	Guaranteed	1.65	8.	9.	2.
	Found	1.70	7.92	10.10	2.38

ANALYSES OF SAMPLES OF FERTILIZERS

NAME AND ADDRESS OF MANUFACTURER OR JOBBER.	Brand or trade name.	Locality where sample was taken.	Number.
Hess & Bro., Inc., S. M., Philadelphia, Pa.	Cauliflower Manure	Riverhead	4166
Hess & Bro., Inc., S. M., Philadelphia, Pa.	Farmers Grain & Clover Grower	E. Williamson	3745
Hess & Bro., Inc., S. M., Philadelphia, Pa.	Nitrate of Soda	Hicksville	3572
Hess & Bro., Inc., S. M., Philadelphia, Pa.	Soluble Phosphate	E. Williamson	3743
Hess & Bro., Inc., S. M., Philadelphia, Pa.	Soluble Phosphate and Potash	Stockton	5005
Hess & Bro., Inc., S. M., Philadelphia, Pa.	Special Cabbage Manure	Riverhead	4167
Hess & Bro., Inc., S. M., Philadelphia, Pa.	Special Compound	E. Williamson	3747
Hess & Bro., Inc., S. M., Philadelphia, Pa.	Special Corn Manure	Crown Point C't'r.	4851
Hess & Bro., Inc., S. M., Philadelphia, Pa.	Special Fish and Potash Manure	E. Williamson	3746
Hess & Bro., Inc., S. M., Philadelphia, Pa.	Special Potato Manure	Hicksville	3571
Hess & Bro., Inc., S. M., Philadelphia, Pa.	Superior Potash Mixture	E. Williamson	3744
Howard, J. W., Somerville, Mass.	Sheep Manure	Newark	4515
Hubbard Fertilizer Co., The, Baltimore, Md.	Hubbard's Blood, Bone & Potash Fertilizer	Unadilla	4220
Hubbard Fertilizer Co., The, Baltimore, Md.	Hubbard's Farmers I X L	Windsor	4392
Hubbard Fertilizer Co., The, Baltimore, Md.	Hubbard's 14% Phosphate	Montour Falls	4735
Hubbard Fertilizer Co., The, Baltimore, Md.	Hubbard's Jersey Trucker	Montour Falls	4734
Hubbard Fertilizer Co., The, Baltimore, Md.	Hubbard's Oriental Phosphate	Unadilla	4221

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric Acid. Available.	Phosphoric Acid. Total.	Potash.
4166	Guaranteed Found	4.11 4.41	5. 5.99	6. 7.17	5. 5.
3745	Guaranteed Found	—— ——	10. 9.44	11. 9.96	8. 6.67
3572	Guaranteed Found	15. 15.50	—— ——	—— ——	—— ——
3743	Guaranteed Found	—— ——	14. 13.44	15. 14.14	—— ——
5005	Guaranteed Found	—— ——	10. 9.42	11. 9.76	2. 2.22
4167	Guaranteed Found	3.29 3.38	6. 6.65	7. 7.83	4. 4.02
3747	Guaranteed Found	.82 .90	8. 8.24	9. 9.	4. 4.18
4851	Guaranteed Found	.82 1.11	8. 8.29	9. 9.63	2. 2.88
3746	Guaranteed Found	2.06 2.05	8. 8.16	9. 9.38	3. 3.36
3571	Guaranteed Found	3.29 3.35	8. 8.84	9. 9.86	7. 7.04
3744	Guaranteed Found	1.65 1.81	8. 6.84	9. 8.25	10. 10.72
4515	Guaranteed Found	—— 2.46	—— ——	—— .91	—— 4.26
4220	Guaranteed Found	3.26 3.31	8. 8.13	9. 8.65	7. 7.30
4392	Guaranteed Found	1.64 1.69	8. 8.54	9. 9.60	2. 2.26
4735	Guaranteed Found	—— ——	14. 15.25	15. 17.39	—— ——
4734	Guaranteed Found	1.64 1.93	8. 7.64	9. 8.65	10. 10.68
4221	Guaranteed Found	.82 1.30	8. 8.25	9. 9.41	2. 2.74

ANALYSES OF SAMPLES OF FERTILIZERS

NAME AND ADDRESS OF MANUFACTURER OR JOBBER.	Brand or trade name.	Locality where sample was taken.	Number.
Hubbard Fertilizer Co., The, Baltimore, Md.	Hubbard's 12-5 Alkaline	Windsor	4393
Husson, T. T., Pomona, N. Y.	Husson Home Made Potato Fertilizer	Pomona	4552
Intern'l Agr'l Corp'n, Buffalo Fert. W'ks, Buffalo, N. Y.	Animal Tankage	Buffalo	5006
Intern'l Agr'l Corp'n, Buffalo Fert. W'ks, Buffalo, N. Y.	Bone Meal	Buffalo	3377
Intern'l Agr'l Corp'n, Buffalo Fert. Works, Buffalo, N. Y.	Buffalo Dry Ground Fish	Baldwinsville	4145
Intern'l Agr'l Corp'n, Buffalo Fert. Works, Buffalo, N. Y.	Celery & Potato Special	West Carthage	2930
Intern'l Agr'l Corp'n, Buffalo Fert. Works, Buffalo, N. Y.	Dissolved Phosphate	Fancher	3838
Intern'l Agr'l Corp'n, Buffalo Fert. Works, Buffalo, N. Y.	Dried Blood	Baldwinsville	4144
Intern'l Agr'l Corp'n, Buffalo Fert. Works, Buffalo, N. Y.	Extra Phosphate & Potash	Ogdensburg	3301
Intern'l Agr'l Corp'n, Buffalo Fert. Works, Buffalo, N. Y.	Farmer's Choice	Lowville	2927
Intern'l Agr'l Corp'n, Buffalo Fert. Works, Buffalo, N. Y.	Fish Guano	Dunkirk	4262
Intern'l Agr'l Corp'n, Buffalo Fert. Works, Buffalo, N. Y.	Fish Tankage	South Lima	4504
Intern'l Agr'l Corp'n, Buffalo Fert. Works, Buffalo, N. Y.	Garbage Tankage	Eden Center	3367
Intern'l Agr'l Corp'n, Buffalo Fert. Works, Buffalo, N. Y.	Garden Truck	Peterboro	4358
Intern'l Agr'l Corp'n, Buffalo Fert. Works, Buffalo, N. Y.	General Crop	Watertown	2938
Intern'l Agr'l Corp'n, Buffalo Fert. Works, Buffalo, N. Y.	General Favorite	South Dayton	4276
Intern'l Agr'l Corp'n, Buffalo Fert. Works, Buffalo, N. Y.	High Grade Manure	Malone	3755

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid.		Potash.
			Available.	Total.	
4393	Guaranteed Found	—— ——	12. 12.01	13. 13.19	5. 5.04
4552	Guaranteed Found	4. 4.04	—— 8.03	9. 9.47	10. 11.48
5006	Guaranteed Found	6.1 6.19	—— ——	—— ——	—— ——
3377	Guaranteed Found	2.4 3.13	—— ——	22. 20.43	—— ——
4145	Guaranteed Found	6.58 5.50	—— 6.79	—— 8.07	—— 1.02
2930	Guaranteed Found	1.6 1.49	8. 8.96	9. 10.40	10. 9.44
3838	Guaranteed Found	—— ——	14. 14.18	15. 14.57	—— ——
4144	Guaranteed Found	9.84 10.53	—— ——	—— ——	—— ——
3301	Guaranteed Found	—— ——	10. 10.74	11. 11.16	8. 7.05
2927	Guaranteed Found	.8 .97	6. 7.98	9. 9.72	5. 5.34
4262	Guaranteed Found	.8 1.04	9. 8.34	10. 9.04	2. 2.26
4504	Guaranteed Found	6.5 7.18	—— ——	—— 1.44	—— 1.29
3367	Guaranteed Found	2.25 2.56	—— ——	4. 3.78	.75 1.10
4358	Guaranteed Found	3.3 3.49	8. 8.07	9. 9.11	7. 6.78
2938	Guaranteed Found	—— ——	9. 8.82	10. 9.54	3. 2.98
4276	Guaranteed Found	1.2 1.26	8. 9.11	9. 9.87	2.5 2.70
3755	Guaranteed Found	3.3 3.33	7. 8.05	8. 9.09	10. 10.20

ANALYSES OF SAMPLES OF FERTILIZERS

NAME AND ADDRESS OF MANUFACTURER OR JOBBER.	Brand or trade name.	Locality where sample was taken.	Number.
Intern'l Agr'l Corp'n, Buffalo Fert. Works, Buffalo, N. Y.	Ideal Wheat & Corn	Malone	3751
Intern'l Agr'l Corp'n, Buffalo Fert. Works, Buffalo, N. Y.	Kainit	Oakfield	4475
Intern'l Agr'l Corp'n, Buffalo Fert. Works, Buffalo, N. Y.	Muriate of Potash	Rochester	3996
Intern'l Agr'l Corp'n, Buffalo Fert. Works, Buffalo, N. Y.	Muriate of Potash	Baldwinsville	4141
Intern'l Agr'l Corp'n, Buffalo Fert. Works, Buffalo, N. Y.	Nitrate of Soda	Rochester	3995
Intern'l Agr'l Corp'n, Buffalo Fert. Works, Buffalo, N. Y.	Nitrate of Soda	Baldwinsville	4143
Intern'l Agr'l Corp'n, Buffalo Fert. Works, Buffalo, N. Y.	Phosphate & Potash	Waterport	4314
Intern'l Agr'l Corp'n, Buffalo Fert. Works, Buffalo, N. Y.	Pure Raw Bone	Sodus	3455
Intern'l Agr'l Corp'n, Buffalo Fert. Works, Buffalo, N. Y.	Sulphate of Potash	Baldwinsville	4142
Intern'l Agr'l Corp'n, Buffalo Fert. Works, Buffalo, N. Y.	Tankage	South Dayton	4277
Intern'l Agr'l Corp'n, Buffalo Fert. Works, Buffalo, N. Y.	Vegetable & Potato	Dunkirk	4263
Intern'l Agr'l Corp'n, Pa. Fert. Branch, Buffalo, N. Y.	Acid Phosphate	Springville	4296
Intern'l Agr'l Corp'n, Pa. Fert. Branch, Buffalo, N. Y.	Big Bonanza	Fancher	3839
Intern'l Agr'l Corp'n, Pa. Fert. Branch, Buffalo, N. Y.	Economy	Fancher	3840
Intern'l Agr'l Corp'n, Pa. Fert. Branch, Buffalo, N. Y.	Empire 10%	Clarence Center	4332
Intern'l Agr'l Corp'n, Pa. Fert. Branch, Buffalo, N. Y.	Four Feed	Buffalo	5007
Intern'l Agr'l Corp'n, Pa. Fert. Branch, Buffalo, N. Y.	Gardeners Special	Lakeville	4505

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid.		Potash.
			Available.	Total.	
3751	Guaranteed	1.6	9.	10.	5.
	Found	1.82	9.60	10.68	5.84
4475	Guaranteed	—	—	—	12.
	Found	—	—	—	12.28
3996	Guaranteed	—	—	—	48.
	Found	—	—	—	51.86
4141	Guaranteed	—	—	—	48.
	Found	—	—	—	50.88
3995	Guaranteed	15.	—	—	—
	Found	15.18	—	—	—
4143	Guaranteed	15.	—	—	—
	Found	15.04	—	—	—
4314	Guaranteed	—	12.	13.	5.
	Found	—	12.44	12.78	5.36
3455	Guaranteed	3.3	—	23.	—
	Found	3.24	—	18.86	—
4142	Guaranteed	—	—	—	48.
	Found	—	—	—	50.36
4277	Guaranteed	6.15	—	—	—
	Found	6.79	—	10.67	—
4263	Guaranteed	2.4	8.	9.	7.
	Found	2.46	7.61	9.37	7.08
4296	Guaranteed	—	12.	13.	—
	Found	—	13.91	14.21	—
3839	Guaranteed	.8	8.	9.	4.
	Found	.89	8.83	9.87	4.
3840	Guaranteed	1.6	8.	9.	4.
	Found	1.61	9.24	10.88	4.88
4332	Guaranteed	1.6	8.	9.	10.
	Found	1.63	8.79	9.43	10.24
5007	Guaranteed	.8	8.	9.	2.
	Found	.81	8.51	9.90	3.23
4505	Guaranteed	2.4	6.	7.	10.
	Found	2.52	6.48	7.06	10.72

ANALYSES OF SAMPLES OF FERTILIZERS

NAME AND ADDRESS OF MANUFACTURER OR JOBBER.	Brand or trade name.	Locality where sample was taken.	Number.
Intern'l Agr'l Corp'n, Pa. Fert. Branch, Buffalo, N.Y.	Grain & Grass	Franklinville	4268
Intern'l Agr'l Corp'n, Pa. Fert. Branch, Buffalo, N.Y.	Potato & Truck Manure	Buffalo	5008
Intern'l Agr'l Corp'n, Pa. Fert. Branch, Buffalo, N.Y.	Standard Phosphate	Wayland	4720
Intern'l Agr'l Corp'n, Pa. Fert. Branch, Buffalo, N.Y.	Standard Phosphate	Buffalo	5010
Intern'l Agr'l Corp'n, Pa. Fert. Branch, Buffalo, N.Y.	Vegetable & Vine	Getzville	4318
International Seed Co., Rochester, N. Y.	International A1 Special Manure	North Collins	4252
International Seed Co., Rochester, N. Y.	International Crop Grower	Guilford	4370
International Seed Co., Rochester, N. Y.	International Electric Fertilizer	Waterville	3671
International Seed Co., Rochester, N. Y.	International Grain & Grass Fertilizer	Cincinnatus	3913
International Seed Co., Rochester, N. Y.	International Potato & Truck Manure	Oriskany Falls	3670
Jarecki Chemical Co., The, Sandusky, O.	Black Diamond Fish Guano	Attica	3500
Jarecki Chemical Co., The, Sandusky, O.	Fish & Potash Garden Fertilizer	Medina	3821
Jarecki Chemical Co., The, Sandusky, O.	Fish & Potash General Grower	Eden Center	3361
Jarecki Chemical Co., The, Sandusky, O.	Fish and Potato Grain Special	Ransomville	4304
Jarecki Chemical Co., The, Sandusky, O.	Fish and Potash Truck Manure	Knowlesville	3834
Jarecki Chemical Co., The, Sandusky, O.	Humus-Phosphate with Potash	Medina	3822
Jarecki Chemical Co., The, Sandusky, O.	Special Cabbage & Onion Guano	Walker	3967

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid. Available.	Phosphoric acid. Total.	Potash.
4268	Guaranteed Found	—— ——	10. 10.35	11. 10.85	2. 2.12
5008	Guaranteed Found	1.6 1.85	8. 7.40	9. 9.31	6. 6.62
4720	Guaranteed Found	—— ——	10. 10.53	11. 11.15	6. 6.18
5010	Guaranteed Found	—— ——	10. 10.42	11. 11.09	6. 6.64
4318	Guaranteed Found	.8 .89	10. 10.34	11. 11.10	8. 8.16
4252	Guaranteed Found	2.47 2.37	6. 6.03	7. 7.07	10. 10.08
4370	Guaranteed Found	.82 .82	7. 6.64	8. 7.22	1. 1.16
3671	Guaranteed Found	.82 1.18	8. 9.47	9. 10.37	2. 2.48
3913	Guaranteed Found	1.23 1.31	10. 10.31	11. 11.35	2.50 2.62
3670	Guaranteed Found	1.23 1.32	8. 8.03	9. 9.41	7. 6.99
3500	Guaranteed Found	1.66 1.68	8. 8.34	—— 9.22	4. 4.64
3821	Guaranteed Found	1.66 1.76	8. 8.70	—— 9.42	10. 10.78
3361	Guaranteed Found	.83 .82	7. 7.55	—— 8.39	3. 3.
4304	Guaranteed Found	.83 .88	8. 8.92	—— 9.42	4. 4.44
3834	Guaranteed Found	3.33 3.30	8. 5.64	—— 8.52	7. 8.76
3822	Guaranteed Found	.20 .22	10. 10.41	—— 10.79	8. 7.81
3967	Guaranteed Found	.83 .86	10. 9.20	—— 10.16	8. 7.96

ANALYSES OF SAMPLES OF FERTILIZERS

Name and Address of Manufacturer or Jobber.	Brand or trade name.	Locality where sample was taken.	Number.
Lattin, Frank H., Albion, N. Y.	Wool Waste Fertilizer	Knowlesville	5012
Listers Agricultural Chemical Co., Newark, N. J.	Genuine German Kainit	Warrensburg	4092
Listers Agricultural Chemical Co., Newark, N. J.	Lister's Ammoniated Dissolved Bone Phosphate	Wallace	4723
Listers Agricultural Chemical Co., Newark, N. J.	Lister's Ammoniated Dissolved Superphosphate	Utica	3653
Listers Agricultural Chemical Co., Newark, N. J.	Lister's Bone Meal	Albany	3303
Listers Agricultural Chemical Co., Newark, N. J.	Lister's Bone Meal	Utica	3666
Listers Agricultural Chemical Co., Newark, N. J.	Lister's Buyer's Choice Acid Phosphate	Skaneateles	3506
Listers Agricultural Chemical Co., Newark, N. J.	Lister's Cauliflower and Cabbage Fertilizer	North Tonawanda	4315
Listers Agricultural Chemical Co., Newark, N. J.	Lister's Celebrated Ground Bone and Tankage Acidulated	Hobart	3632
Listers Agricultural Chemical Co., Newark, N. J.	Lister's Corn No. 2 Fertilizer	Skaneateles	3502
Listers Agricultural Chemical Co., Newark, N. J.	Lister's Dissolved Phosphate and Potash	Cherry Valley	3328
Listers Agricultural Chemical Co., Newark, N. J.	Lister's Excelsior Guano	Cincinnatus	3908
Listers Agricultural Chemical Co., Newark, N. J.	Lister's G. Brand	Utica	3665
Listers Agricultural Chemical Co., Newark, N. J.	Lister's Grain and Grass Fertilizer	Utica	3668
Listers Agricultural Chemical Co., Newark, N. J.	Lister's New York Special Fertilizer	Utica	3664
Listers Agricultural Chemical Co., Newark, N. J.	Lister's Oneida Special	Utica	3667

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid. Available.	Phosphoric acid. Total.	Potash.
5012	Guaranteed Found	.75 1.29	.75 .17	—— .31	2. 3.63
4092	Guaranteed Found	—— ——	—— ——	—— ——	12. 13.40
4723	Guaranteed Found	2.06 2.10	8. 8.63	9. 10.17	1.50 2.04
3653	Guaranteed Found	2. 2.09	8. 8.06	9. 9.84	1.50 1.56
3303	Guaranteed Found	2.67 3.28	—— ——	22.88 23.82	—— ——
3666	Guaranteed Found	2.67 3.74	—— ——	22.88 24.54	—— ——
3506	Guaranteed Found	—— ——	14. 14.33	15. 14.49	—— ——
4315	Guaranteed Found	3.29 3.55	8. 8.50	9. 9.70	7. 7.50
3632	Guaranteed Found	2.67 3.31	6. 8.59	12. 10.69	—— 2.72
3502	Guaranteed Found	1.65 1.84	10. 10.36	11. 11.94	4. 4.16
3328	Guaranteed Found	—— ——	10. 10.40	11. 10.64	2. 2.28
3908	Guaranteed Found	.82 1.22	9. 9.73	10. 10.99	7. 7.20
3665	Guaranteed Found	.82 1.04	8. 8.29	9. 9.29	4. 3.98
3668	Guaranteed Found	—— ——	9. 8.56	10. 9.06	5. 4.72
3664	Guaranteed Found	.82 1.05	8. 8.02	9. 9.16	10. 10.08
3667	Guaranteed Found	.82 1.01	7. 6.78	8. 8.17	1. 1.10

ANALYSES OF SAMPLES OF FERTILIZERS

NAME AND ADDRESS OF MANUFACTURER OR JOBBER.	Brand or trade name.	Locality where sample was taken.	Number.
Listers Agricultural Chemical Co., Newark, N. J.	Lister's Orchard Fertilizer	Hilton	3963
Listers Agricultural Chemical Co., Newark, N. J.	Lister's Potato Manure	Utica	3656
Listers Agricultural Chemical Co., Newark, N. J.	Lister's Potato No. 2 Fertilizer	Utica	3655
Listers Agricultural Chemical Co., Newark, N. J.	Lister's Reliance	Trumansburg	4407
Listers Agricultural Chemical Co., Newark, N. J.	Lister's Special Crop Producer	Getzville	4321
Listers Agricultural Chemical Co., Newark, N. J.	Lister's Special 10% Potato Fertilizer	Utica	3654
Listers Agricultural Chemical Co., Newark, N. Y.	Lister's Special Wheat Fertilizer	Getzville	4322
Listers Agricultural Chemical Co., Newark, N. J.	Lister's Success	Utica	3651
Listers Agricultural Chemical Co., Newark, N. J.	Lister's Standard Pure Superphosphate of Lime	Utica	3669
Listers Agricultural Chemical Co., Newark, N. J.	Lister's Superior Dissolved Phosphate and Potash	Albion	3829
Listers Agricultural Chemical Co., Newark, N. J.	Lister's 3-6-10 For Potatoes	Cincinnatus	3907
Listers Agricultural Chemical Co., Newark, N. J.	Lister's U. S. Super Phosphate	Newark Valley	4424
Listers Agricultural Chemical Co., Newark, N. J.	Lister's Wheat and Rye Fertiliser	Cato	4025
Listers Agricultural Chemical Co., Newark, N. J.	Muriate of Potash	Hilton	3964
Lowell Fertilizer Co., Boston, Mass.	Ground Tankage	Arkport	4048
Lowell Fertilizer Co., Boston, Mass.	Lowell Acid Phosphate	Glen	4228

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid. Available.	Phosphoric acid. Total.	Potash.
3963	Guaranteed Found	—— ——	6. 6.33	7. 6.33	10. 10.20
3656	Guaranteed Found	3.29 3.40	8. 8.34	9. 9.68	7. 7.20
3655	Guaranteed Found	1.65 1.82	10. 9.54	11. 11.57	4. 4.44
4407	Guaranteed Found	1.03 1.15	8. 8.27	9. 9.57	2. 2.16
4321	Guaranteed Found	.82 .90	7. 7.08	8. 8.24	1. 1.34
3654	Guaranteed Found	1.65 1.83	8. 7.51	9. 9.18	10. 10.44
4322	Guaranteed Found	1.65 1.77	8. 7.92	9. 9.32	3. 3.30
3651	Guaranteed Found	1.23 1.43	9. 9.05	10. 10.83	2. 2.16
3669	Guaranteed Found	2.67 2.59	9. 9.66	10. 10.52	2. 2.18
3829	Guaranteed Found	—— ——	10. 10.62	11. 10.74	8. 8.50
3907	Guaranteed Found	2.47 2.69	6. 5.75	7. 7.83	10. 10.64
4424	Guaranteed Found	1.03 1.11	8. 8.33	9. 9.67	2. 2.20
4025	Guaranteed Found	1.65 1.75	8. 8.33	9. 9.71	2. 2.30
3964	Guaranteed Found	—— ——	—— ——	—— ——	49. 50.24
4048	Guaranteed Found	5. 4.19	—— ——	14. 19.62	—— ——
4228	Guaranteed Found	—— ——	14. 16.26	15. 17.64	—— ——

ANALYSES OF SAMPLES OF FERTILIZERS

Name and Address of Manufacturer or Jobber.	Brand or trade name.	Locality where sample was taken.	Number.
Lowell Fertilizer Co., Boston, Mass.	Lowell Animal Brand for all Crops	Cobleskill	3309
Lowell Fertilizer Co., Boston, Mass.	Lowell Bone Fertilizer for Corn, Grass, Grain and Vegetables	Cobleskill	3305
Lowell Fertilizer Co., Boston, Mass.	Lowell Cereal Fertilizer	Cobleskill	3306
Lowell Fertilizer Co., Boston, Mass.	Lowell Corn and Vegetable	Cortland	3904
Lowell Fertilizer Co., Boston, Mass.	Lowell Dissolved Bone & Potash	Cobleskill	3308
Lowell Fertilizer Co., Boston, Mass.	Lowell Empress Brand for Corn, Potatoes & Grain	Cobleskill	3304
Lowell Fertilizer Co., Boston, Mass.	Lowell Grain Phosphate	Middle Granville	4071
Lowell Fertilizer Co., Boston, Mass.	Lowell Potato Grower with 10% Potash	Binghamton	4389
Lowell Fertilizer Co., Boston, Mass.	Lowell Potato Manure	Deposit	4112
Lowell Fertilizer Co., Boston, Mass.	Lowell Potato Phosphate	Hoosick Falls	4063
Lowell Fertilizer Co., Boston, Mass.	Lowell Soluble Phosphate	Cortland	3905
Lowell Fertilizer Co., Boston, Mass.	Lowell Special Potato Fertilizer with 10% Potash	Warrensburg	4091
Lowell Fertilizer Co., Boston, Mass.	Lowell Sterling Phosphate	Eagle Bridge	4065
Lowell Fertilizer Co., Boston, Mass.	Lowell Superior Fertilizer with 10% Potash	Binghamton	4388
Lowell Fertilizer Co., Boston, Mass.	Lowell Vegetable and Grain Fertilizer	Cobleskill	3307
Lowell Fertilizer Co., Boston, Mass.	Muriate of Potash	Deposit	4114

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen	Phosphoric Acid. Available.	Phosphoric Acid. Total.	Potash.
3309	Guaranteed Found	2.46 2.40	8. 8.35	9. 9.31	4. 4.98
3305	Guaranteed Found	1.64 1.60	8. 8.13	9. 9.01	3. 3.04
3306	Guaranteed Found	.82 .86	7. 6.48	8. 7.18	1. 1.08
3904	Guaranteed Found	3.28 3.24	8. 8.44	9. 9.60	7. 7.80
3308	Guaranteed Found	1.64 1.80	9. 10.55	10. 13.27	2. 2.48
3304	Guaranteed Found	1.24 1.30	7. 7.19	8. 8.19	2. 2.22
4071	Guaranteed Found	—— ——	10. 10.10	11. 11.36	8. 7.84
4389	Guaranteed Found	3.28 3.01	6. 7.17	7. 7.85	10. 10.20
4112	Guaranteed Found	1.64 1.71	7. 7.17	8. 7.95	4. 4.30
4063	Guaranteed Found	2.46 2.44	8. 8.17	9. 9.01	6. 6.06
3905	Guaranteed Found	—— ——	12. 12.96	13. 13.44	—— ——
4091	Guaranteed Found	2.46 2.42	6. 6.25	7. 7.09	10. 10.24
4065	Guaranteed Found	.82 .84	8. 7.71	9. 8.45	4. 3.83
4388	Guaranteed Found	3.69 3.85	7. 7.36	8. 8.32	10. 10.72
3307	Guaranteed Found	1.64 1.73	8. 7.90	9. 9.15	10. 10.
4114	Guaranteed Found	—— ——	—— ——	—— ——	50. 49.88

ANALYSES OF SAMPLES OF FERTILIZERS

Name and Address of Manufacturer or Jobber.	Brand or trade name.	Locality where sample was taken.	Number.
Lowell Fertilizer Co., Boston, Mass.	Nitrate of Soda	Middle Granville	4072
Ludlam Co., Frederick, New York, N. Y.	Ludlam's A. B. F. Fertilizer	Oyster Bay	3567
Ludlam Co., Frederick, New York, N. Y.	Ludlam's Antler Fertilizer	Tiashoke	4068
Ludlam Co., Frederick, New York, N. Y.	Ludlam's Cecrops Fertilizer	Oyster Bay	3568
Ludlam Co., Frederick, New York, N. Y.	Ludlam's Fruit and Vine Fertilizer	East Greenbush	4952
Ludlam Co., Frederick, New York, N. Y.	Ludlam's Palmetto Fertilizer	Coxsackie	3897
Ludlam Co., Frederick, New York, N. Y.	Ludlam's P. G. Phosphate	Albany	4953
Ludlam Co., Frederick, New York, N. Y.	Ludlam's Special Potato Fertilizer	Oyster Bay	3566
Lyon, S. G., Aurora, N. Y.	S. G. Lyon's Ammoniated Bone Super-Phosphate	Aurora	4032
McCoy, George E., Peekskill, N. Y.	An Honest Fertilizer	Peekskill	3880
Mapes Formula & Peruvian Guano Co., The, New York	Pure Ground Bone	Babylon	4602
Mapes Formula & Peruvian Guano Co., The, New York	The Mapes Average Soil Complete Manure	Baldwinsville	4352
Mapes Formula & Peruvian Guano Co., The, New York	The Mapes Cauliflower and Cabbage Manure	Mattituck	4186
Mapes Formula & Peruvian Guano Co., The, New York	The Mapes Complete Manure 10% Potash	Utica	3302
Mapes Formula & Peruvian Guano Co., The, New York	The Mapes Corn Manure	Mattituck	4187
Mapes Formula & Peruvian Guano Co., The, New York	The Mapes Economical Potato Manure	Baldwinsville	4351
Mapes Formula & Peruvian Guano Co., The, New York	The Mapes General Crop Brand	White Plains	3874

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid. Available.	Phosphoric acid. Total.	Potash.
4072	Guaranteed Found	15. 15.20	—— ——	—— ——	—— ——
3567	Guaranteed Found	1.65 1.82	8. 8.40	9. 10.78	2. 2.86
4068	Guaranteed Found	3.29 3.32	6. 7.05	7. 8.39	10. 11.02
3568	Guaranteed Found	3.29 3.47	7. 6.34	8. 8.48	7. 7.18
4952	Guaranteed Found	.82 1.47	8. 7.95	9. 9.36	10. 10.38
3897	Guaranteed Found	.82 .81	8. 8.34	9. 9.16	4. 3.61
4953	Guaranteed Found	—— ——	10. 12.52	11. 13.11	6. 3.87
3566	Guaranteed Found	2.47 2.73	8. 7.71	9. 9.58	6. 6.08
4032	Guaranteed Found	1.22 1.33	8. 8.33	9. 9.91	3. 3.44
3880	Guaranteed Found	5. 5.50	—— ——	16 19.61	—— ——
4602	Guaranteed Found	2.47 2.64	—— ——	20. 28.60	—— ——
4352	Guaranteed Found	4.12 4.11	7. 7.69	8. 8.43	5. 5.60
4186	Guaranteed Found	4.12 4.27	6. 6.89	6. 7.25	6. 7.18
3302	Guaranteed Found	2.06 2.46	3. 3.97	5. 5.51	10. 9.90
4187	Guaranteed Found	2.47 3.14	8. 9.59	10. 11.11	6. 6.74
4351	Guaranteed Found	3.29 3.55	4. 5.49	6. 6.97	8. 9.02
3874	Guaranteed Found	1.65 1.77	8. 9.49	10. 10.59	2. 2.20

ANALYSES OF SAMPLES OF FERTILIZERS

Name and Address of Manufacturer or Jobber.	Brand or trade name.	Locality where sample was taken.	Number
Mapes Formula & Peruvian Guano Co., The, New York	The Mapes Nitrogenized Super Phosphate	Coxsackie	3895
Mapes Formula & Peruvian Guano Co., The, New York	The Mapes Potato Manure (L. I. Special)	Sayville	4601
Mapes Formula & Peruvian Guano Co., The, New York	The Mapes Tobacco Manure Wrapper Brand	Baldwinsville	4431
Martin Co., D. B., Philadelphia, Pa.	Martin's Gilt Edge Potato Manure	Syracuse	3535
Martin Co., D. B., Philadelphia, Pa.	Martin's High Grade Potato	Syracuse	3534
Martin Co., D. B., Philadelphia, Pa.	Martin's Potash & Soluble Phosphate	Prattsburg	4728
Martin Co., D. B., Philadelphia, Pa.	Martin's Prize Potato	Syracuse	3533
Martin Co., D. B., Philadelphia, Pa.	Martin's Special Compound	Syracuse	3532
Martin Co., D. B., Philadelphia, Pa.	Martin's Special Potato Manure	Syracuse	3531
Martin Co., D. B., Philadelphia, Pa.	Martin's Trucker Guano	Prattsburg	4729
Mittenmaier Fertilizer Co., Rome, N. Y.	Hop & Potato Fertilizer	Canastota	4661
Mittenmaier Fertilizer Co., Rome, N. Y.	Super Phosphate	Rome	4206
Mittenmaier Fertilizer Co., Rome, N. Y.	Super Phosphate	Canastota	4662
Moller & Co., Maspeth, L. I.	Champion No. 1 Pure Bone Fertilizer	Maspeth	4626
Moller & Co., Maspeth, L. I.	Champion No. 2 Pure Bone Fertilizer	Maspeth	4627
Nassau Fertilizer Co., New York, N. Y.	General Favorite	Lowville	2925
Nassau Fertilizer Co., New York, N. Y.	Soluble Phosphate	Ballston Spa.	4096

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid. Available.	Phosphoric acid. Total.	Potash.
3895	Guaranteed	2.06	9.	11.	2.50
	Found	2.04	8.71	11.59	3.48
4601	Guaranteed	3.29	4.	6.	7.
	Found	3.35	5.01	6.57	7.16
4431	Guaranteed	6.18	———	4.50	10.50
	Found	6.45	———	5.62	12.45
3535	Guaranteed	2.47	7.	———	10.
	Found	2.71	7.86	8.48	9.41
3534	Guaranteed	3.30	8.	———	10.
	Found	3.05	8.41	8.81	10.08
4728	Guaranteed	———	10.	———	8.
	Found	———	10.40	11.06	6.71
3533	Guaranteed	1.65	8.	———	10.
	Found	1.72	8.69	9.57	10.30
3532	Guaranteed	1.65	8.	———	5.
	Found	1.76	9.26	10.48	5.32
3531	Guaranteed	.82	8.	———	5.
	Found	1.04	9.09	10.27	4.68
4729	Guaranteed	3.30	8.	———	7.
	Found	3.27	9.50	11.14	6.32
4661	Guaranteed	1.00	8.	———	3.
	Found	.79	6.98	8.93	3.12
4206	Guaranteed	2.00	8.	———	3.
	Found	.82	8.42	9.24	3.72
4662	Guaranteed	2.00	8.	———	3.
	Found	.90	6.30	10.80	3.82
4626	Guaranteed	2.88	7.	———	6.
	Found	3.29	9.03	11.85	9.28
4627	Guaranteed	3.30	7.	———	5.
	Found	3.33	8.76	13.72	5.68
2925	Guaranteed	.82	8.	9.	4.
	Found	.92	8.42	9.62	4.10
4096	Guaranteed	———	14.	15.	———
	Found	———	14.82	16.	———

ANALYSES OF SAMPLES OF FERTILIZERS

NAME AND ADDRESS OF MANUFACTURER OR JOBBER.	Brand or trade name.	Locality where sample was taken.	Number.
Nassau Fertilizer Co., New York, N. Y.	Special Potato Fertilizer	Ballston Spa	4097
Nassau Fertilizer Co., New York, N. Y.	Ten & Eight Special	Afton	4397
Nassau Fertilizer Co., New York, N. Y.	Wheat & Grass Grower	Lowville	2926
National Fertilizer Co., The, New York, N. Y.	National Complete Root and Grain Fertilizer	Eastport	4188
National Fertilizer Co., The, New York, N. Y.	National Complete Root Fertilizer "Special"	Calverton	4172
National Fertilizer Co., The, New York, N. Y.	National XXX Fish and Potash	Calverton	4171
National Guano Co., Aurora, Ill.	Sheep's Head Brand Pulverized Sheep Manure	Buffalo	3391
National Guano Co., Aurora, Ill.	Sheep's Head Brand Pulverized Sheep Manure	Jamaica	3593
National Guano Co., Aurora, Ill.	Sheep's Head Brand Pulverized Sheep Manure	Yonkers	3859
New England Fertilizer Co., Boston, Mass.	Dissolved Bone Black	Granville	4077
New England Fertilizer Co., Boston, Mass.	New England Corn Phosphate	Granville	4078
New England Fertilizer Co., Boston, Mass.	New England Potato Fertilizer	Gouverneur	3770
New England Fertilizer Co., Boston, Mass.	New England Standard Phosphate	Gouverneur	3771
Newhof & Son, Lewis, Albany, N. Y.	Pure Fertilizer	Albany	3350
N. Y. State Grange Purchasing Agency, Olean, N. Y.	Bone Meal	Webster	4008
N. Y. State Grange Purchasing Agency, Olean, N. Y.	Muriate of Potash	Brockport	3468
N. Y. State Grange Purchasing Agency, Olean, N. Y.	Patrons—P of H—4-8-7	Port Byron	3482

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid. Available.	Phosphoric acid. Total.	Potash.
4097	Guaranteed Found	1.65 1.68	8. 8.51	9. 10.35	10. 10.72
4397	Guaranteed Found	—— ——	10. 10.55	11. 11.11	8. 8.34
2926	Guaranteed Found	.82 1.03	8. 8.42	9. 10.08	2. 2.18
4188	Guaranteed Found	3.29 3.30	8. 8.61	9. 9.85	6. 6.62
4172	Guaranteed Found	3.29 3.29	8. 8.27	9. 9.35	7. 7.47
4171	Guaranteed Found	2.47 2.45	5. 6.03	6. 6.73	3. 2.96
3391	Guaranteed Found	2.25 2.40	1. 1.31	1.25 1.45	1.50 1.96
3593	Guaranteed Found	2.25 2.37	1. 1.35	1.25 1.49	1.50 2.
3859	Guaranteed Found	2.25 2.35	1. 1.29	1.25 1.43	1.50 2.29
4077	Guaranteed Found	—— ——	15. 15.26	—— 18.56	—— ——
4078	Guaranteed Found	1.64 1.65	8. 8.53	9. 9.33	3. 2.96
3770	Guaranteed Found	1.64 1.67	7. 7.28	8. 8.03	4. 4.24
3771	Guaranteed Found	.82 .83	8. 7.73	9. 8.48	4. 4.02
3350	Guaranteed Found	5.5 5.62	—— ——	9. 12.93	—— ——
4008	Guaranteed Found	—— 4.32	—— ——	—— 21.97	—— ——
3468	Guaranteed Found	—— ——	—— ——	—— ——	49. 51.32
3482	Guaranteed Found	3.29 3.28	8. 8.20	8.50 9.18	7. 7.50

ANALYSES OF SAMPLES OF FERTILIZERS

NAME AND ADDRESS OF MANUFACTURER OR JOBBER.	Brand or trade name.	Locality where sample was taken.	Number.
N. Y. State Grange Purchasing Agency, Olean, N. Y.	Patrons—P of H—4-8-7	Troy	4858
N. Y. State Grange Purchasing Agency, Olean, N. Y.	Patrons—P of H—4-6-10	Albany	4085
N. Y. State Grange Purchasing Agency, Olean, N. Y.	Patrons—P of H—14%	Frewsburg	3279
N. Y. State Grange Purchasing Agency, Olean, N. Y.	Patrons—P of H—14%	Brockport	3471
N. Y. State Grange Purchasing Agency, Olean, N. Y.	Patrons—P of H—14%	West Sand Lake	4856
N. Y. State Grange Purchasing Agency, Olean, N. Y.	Patrons—P of H—1-8-4	Red Creek	3728
N. Y. State Grange Purchasing Agency, Olean, N. Y.	Patrons—P of H—10-8	Port Byron	3481
N. Y. State Grange Purchasing Agency, Olean, N. Y.	Patrons—P of H—10-8	West Sand Lake	4854
N. Y. State Grange Purchasing Agency, Olean, N. Y.	Patrons—P of H—2-8-5	Jamestown	3280
N. Y. State Grange Purchasing Agency, Olean, N. Y.	Patrons—P of H—2-8-5	West Sand Lake	4853
N. Y. State Grange Purchasing Agency, Olean, N. Y.	Patrons—P of H—2-8-10	Jamestown	3281
N. Y. State Grange Purchasing Agency, Olean, N. Y.	Patrons—P cf H—2-8-10	Brockport	3469
N. Y. State Grange Purchasing Agency, Olean, N. Y.	Patrons—P of H—2-8-10	Port Byron	3483
N. Y. State Grange Purchasing Agency, Olean, N. Y.	Patrons—P of H—2-8-10	Troy	4857
N. Y. State Grange Purchasing Agency, Olean, N. Y.	Raw Bone Meal	West Sand Lake	4855
Niantic Menhaden Oil & Guano Co., The, South Lyme, Conn.	Acidulated Fish Guano	Southold	4176

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid.		Potash.
			Available.	Total.	
4858	Guaranteed Found	3.29 3.03	8. 8.49	8.50 9.16	7. 8.16
4085	Guaranteed Found	3.29 3.30	6. 6.01	6.50 6.71	10. 10.20
3279	Guaranteed Found	—— ——	14. 13.95	14.50 15.13	—— ——
3471	Guaranteed Found	—— ——	14. 14.18	14.50 15.46	—— ——
4856	Guaranteed Found	—— ——	14. 14.48	14.50 14.59	—— ——
3728	Guaranteed Found	.82 .94	8. 7.86	8.50 9.38	4. 4.20
3481	Guaranteed Found	—— ——	10. 10.27	10.50 10.69	8. 8.96
4854.	Guaranteed Found	—— ——	10. 9.97	10.50 10.53	8. 8.24
3280	Guaranteed Found	1.65 1.67	8. 8.10	8.50 9.86	5. 5.72
4853	Guaranteed Found	1.65 1.69	8. 7.53	8.50 8.16	5. 5.96
3281	Guaranteed Found	1.65 1.66	8. 7.57	8.50 7.97	10. 10.14
3469	Guaranteed Found	1.65 1.72	8. 8.	8.50 9.40	10. 10.44
3483	Guaranteed Found	1.65 1.83	8. 8.05	8.50 9.03	10. 10.80
4857	Guaranteed Found	1.65 1.64	8. 8.28	8.50 8 79	10. 10.36
4855	Guaranteed Found	3.7 4.21	—— ——	22. 21.40	—— ——
4176	Guaranteed Found	3.30 4.22	2.50 4.70	3.50 7.29	—— ——

ANALYSES OF SAMPLES OF FERTILIZERS

Name and Address of Manufacturer or Jobber.	Brand or trade name.	Locality where sample was taken.	Number.
Niantic Menhaden Oil & Guano Co., The, South Lyme, Conn.	Bone, Fish & Potash	Mattituck	4159
Niantic Menhaden Oil & Guano Co., The, South Lyme, Conn.	Dry Ground Fish Guano	Laurel	4163
Nitrate Agencies Co., New York, N. Y.	Ground Bone	New Paltz	3611
Nitrate Agencies Co., New York, N. Y.	Ground Tankage 7-30	Riverhead	4151
Nitrate Agencies Co., New York, N. Y.	High Grade Acid Phosphate	Kings Park	3560
Nitrate Agencies Co., New York, N. Y.	High Grade Acid Phosphate	New Paltz	3610
Nitrate Agencies Co., New York, N. Y.	Muriate of Potash	Kings Park	3561
Nitrate Agencies Co., New York, N. Y.	Muriate of Potash	New Paltz	3612
Nitrate Agencies Co., New York, N. Y.	Nitrate of Soda	Freeport	3559
Nitrate Agencies Co., New York, N. Y.	Nitrate of Soda	Milton	3604
Nitrate Agencies Co., New York, N. Y.	Nitrate of Soda	Kings Park	3562
Nitrate Agencies Co., New York, N. Y.	Sulphate of Potash	Baldwinsville	4149
Pan American Fertilizer Co., New York, N. Y.	Orchard & Fruit Special	Milton	3606
Pan American Fertilizer Co., York, N. Y.	Pan American Favorite Phosphate	Attica	3496
Pan American Fertilizer Co., New York, N. Y.	Pan American General Grain Grower	Farnham	4257
Pan American Fertilizer Co., New York, N. Y.	Pan American Harvest Winner	Attica	3497

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid.		Potash.
			Available.	Total.	
4159	Guaranteed Found	2.46 3.28	5. 5.29	6. 5.79	3. 3.
4163	Guaranteed Found	6.59 7.21	3.50 5.78	6. 6.76	—— ——
3611	Guaranteed Found	2.46 2.12	—— ——	22.88 27.35	—— ——
4151	Guaranteed Found	5.75 5.21	—— ——	13.73 14.82	—— ——
3560	Guaranteed Found	—— ——	14. 15.14	—— 16.14	—— ——
3610	Guaranteed Found	—— ——	14. 16.57	—— 16.73	—— ——
3561	Guaranteed Found	—— ——	—— ——	—— ——	50. 49.84
3612	Guaranteed Found	—— ——	—— ——	—— ——	50. 52.94
3559	Guaranteed Found	15. 15.32	—— ——	—— ——	—— ——
3604	Guaranteed Found	15. 15.49	—— ——	—— ——	—— ——
3562	Guaranteed Found	15. 15.41	—— ——	—— ——	—— ——
4149	Guaranteed Found	—— ——	—— ——	—— ——	48. 50.52
3606	Guaranteed Found	1.64 1.84	8. 8.28	9. 9.12	10. 10.14
3496	Guaranteed Found	1.64 1.59	8. 6.78	9. 7.93	4. 4.24
4257	Guaranteed Found	.82 .88	8. 7.36	9. 8.36	4. 4.24
3497	Guaranteed Found	—— ——	12. 12.91	13. 14.19	5. 4.69

ANALYSES OF SAMPLES OF FERTILIZERS

Name and Address of Manufacturer or Jobber.	Brand or trade name.	Locality where sample was taken.	Number.
Pan American Fertilizer Co., New York, N. Y.	Pan American Ideal Compound	Milton	3605
Pan American Fertilizer Co., New York, N. Y.	Pan American Orchard & Fruit Special	Attica	3498
Pan American Fertilizer Co., New York, N. Y.	Pan American 10-8 Phosphate	Kendaia	4702
Pan American Fertilizer Co., New York, N. Y.	Pan American Vegetable & Potato Special	Riverhead	4175
Patapsco Guano Co., Baltimore, Md.	Patapsco Alkaline Plant Food	Oxford	4105
Patapsco Guano Co., Baltimore, Md.	Patapsco Coon Brand Guano	Oxford	4106
Patapsco Guano Co., Baltimore, Md.	Patapsco Empire Alkaline Bone	Oxford	4103
Patapsco Guano Co., Baltimore, Md.	Patapsco Grain & Grass Producer	Clinton	3678
Patapsco Guano Co., Baltimore, Md.	Patapsco O. K. Phosphate	Oxford	4104
Patapsco Guano Co., Baltimore, Md.	Patapsco Peerless Potato Guano	Williamstown	4226
Patapsco Guano Co., Baltimore, Md.	Patapsco Prolific Potato Phosphate	Hobart	3630
Patapsco Guano Co., Baltimore, Md.	Patapsco Special Potato Guano	Port Leyden	2918
Patapsco Guano Co., Baltimore, Md.	Patapsco Superior Alkaline Manure	Clinton	3676
Patapsco Guano Co., Baltimore, Md.	Patapsco Vegetable & Corn Fertilizer	Port Leyden	2919
Pennsylvania Fertilizer Co., The, Buffalo, N. Y.	Grain Special	Buffalo	5009
Piedmont-Mt. Airy Guano Co., Baltimore, Md.	Blood	Fulton	4224

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid.		Potash.
			Available.	Total.	
3605	Guaranteed	2.46	8.	9.	4.
	Found	2.74	7.32	7.78	4.04
3498	Guaranteed	1.64	8.	9.	10.
	Found	3.21	5.88	6.56	10.15
4702	Guaranteed	——	10.	11.	8.
	Found	——	8.23	12.18	8.32
4175	Guaranteed	3.28	6.	7.	10.
	Found	3.31	6.25	6.71	10.50
4105	Guaranteed	——	8.	9.	5.
	Found	——	8.69	9.47	5.
4106	Guaranteed	.82	9.	10.	3.
	Found	.94	9.63	10.55	3.20
4103	Guaranteed	——	12.	13.	5.
	Found	——	12.68	13.54	4.69
3678	Guaranteed	.82	8.	9.	4.
	Found	.84	8.25	9.49	4.32
4104	Guaranteed	.82	8.	9.	2.
	Found	1.16	8.71	9.83	2.46
4226	Guaranteed	3.29	6.	7.	10.
	Found	3.40	7.	7.96	10.38
3630	Guaranteed	3.29	8.	9.	7.
	Found	3.26	8.19	11.09	7.12
2918	Guaranteed	1.65	8.	9.	10.
	Found	1.85	8.93	10.63	10.32
3676	Guaranteed	——	10.	11.	8.
	Found	——	9.79	10.41	8.36
2919	Guaranteed	1.65	8.	9.	4.
	Found	1.65	8.41	9.75	4.12
5009	Guaranteed	2.	8.	9.	1.5
	Found	2.06	7.44	9.04	2.43
4224	Guaranteed	——	——	——	——
	Found	13.48	——	——	——

ANALYSES OF SAMPLES OF FERTILIZERS

Name and Address of Manufacturer or Jobber.	Brand or trade name.	Locality where sample was taken.	Number.
Piedmont-Mt. Airy Guano Co., Baltimore, Md.	Bone Tankage	West Falls	4286
Piedmont-Mt. Airy Guano Co., Baltimore, Md.	Insula Guano for All Crops	Holland	5003
Piedmont-Mt. Airy Guano Co., Baltimore, Md.	Levering's Harvest Queen	Breesport	4711
Piedmont-Mt. Airy Guano Co., Baltimore, Md.	Levering's Standard	Lyons Falls	2922
Piedmont-Mt. Airy Guano Co., Baltimore, Md.	Long Island Special	West Falls	4293
Piedmont-Mt. Airy Guano Co., Baltimore, Md.	Muriate of Potash	Clyde	4018
Piedmont-Mt. Airy Guano Co., Baltimore, Md.	New York Cabbage & Potato Guano	North Rose	3723
Piedmont-Mt. Airy Guano Co., Baltimore, Md.	Nitrate of Soda	West Falls	4290
Piedmont-Mt. Airy Guano Co., Baltimore, Md.	Piedmont Banner Brand	West Falls	4294
Piedmont-Mt. Airy Guano Co., Baltimore, Md.	Piedmont Bone Meal	Java	4036
Piedmont-Mt. Airy Guano Co., Baltimore, Md.	Piedmont Celery & Vegetable Compound	Weedsport	4022
Piedmont-Mt. Airy Guano Co., Baltimore, Md.	Piedmont Early Vegetable Manure	Riverhead	4174
Piedmont-Mt. Airy Guano Co., Baltimore, Md.	Piedmont Farmers Favorite	Sherburne	4127
Piedmont-Mt. Airy Guano Co., Baltimore, Md.	Piedmont 14% Acid Phosphate	Knowlesville	3836
Piedmont-Mt. Airy Guano Co., Baltimore, Md.	Piedmont New York Vegetable Manure	Port Byron	4020
Piedmont-Mt. Airy Guano Co., Baltimore, Md.	Piedmont Oats & Grass Guano	Harpersville	4390
Piedmont-Mt. Airy Guano Co., Baltimore, Md.	Piedmont Pea & Bean Grower	Sherburne	4128

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid. Available.	Phosphoric acid. Total.	Potash.
4286	Guaranteed	5.76	——	13.75	——
	Found	6.59	——	13.52	——
5003	Guaranteed	.42	7.	——	2.
	Found	.47	7.78	8.22	2.
4711	Guaranteed	.82	8.	——	2.
	Found	.80	8.58	9.84	2.46
2922	Guaranteed	1.65	8.	——	3.
	Found	1.63	8.51	9.71	3.98
4293	Guaranteed	3.29	7.	11.	7.
	Found	3.24	7.48	9.75	6.95
4018	Guaranteed	——	——	——	50.
	Found	——	——	——	48.02
3723	Guaranteed	1.65	8.	——	10.
	Found	1.63	8.68	9.85	11.24
4290	Guaranteed	15.23	——	——	——
	Found	15.27	——	——	——
4294	Guaranteed	3.29	6.	——	10.
	Found	3.36	6.12	8.51	10.64
4036	Guaranteed	3.29	——	21.	——
	Found	3.48	——	23.94	——
4022	Guaranteed	2.47	6.	——	10.
	Found	2.12	6.47	8.06	10.31
4174	Guaranteed	4.12	8.	——	5.
	Found	4.	8.60	10.10	4.90
4127	Guaranteed	.82	8.	——	4.
	Found	.85	8.02	8.96	4.26
3836	Guaranteed	——	14.	——	——
	Found	——	15.93	16.23	——
4020	Guaranteed	3.29	8.	——	6.
	Found	3.06	8.61	9.61	6.78
4390	Guaranteed	——	10.	——	2.
	Found	——	10.52	10.96	2.02
4128	Guaranteed	.82	7.	——	9.
	Found	.84	7.01	7.71	9.90

ANALYSES OF SAMPLES OF FERTILIZERS

NAME AND ADDRESS OF MANUFACTURER OR JOBBER.	Brand or trade name.	Locality where sample was taken.	Number.
Piedmont-Mt. Airy Guano Co., Baltimore, Md.	Piedmont Perfection Guano	Barneveld	4201
Piedmont-Mt. Airy Guano Co., Baltimore, Md.	Piedmont Raw & Dissolved Bone	West Falls	4292
Piedmont-Mt. Airy Guano Co., Baltimore, Md.	Piedmont 16% Acid Phosphate	Baldwinsville	4148
Piedmont-Mt. Airy Guano Co., Baltimore, Md.	Piedmont Special Mixture	Middleport	3802
Piedmont-Mt. Airy Guano Co., Baltimore, Md.	Piedmont Wheat & Corn Guano	Barneveld	4202
Piedmont-Mt. Airy Guano Co., Baltimore, Md.	Piedmont Wheat Compound	Clyde	4016
Piedmont-Mt. Airy Guano Co., Baltimore, Md.	Thomas Phosphate Powder (Basic Slag Phosphate)	West Falls	4291
Pine & Son, B. J., East Williston, L. I.	Pine's No. 1 Star Raw Bone Super-Phosphate	East Williston	3583
Pine & Son, B. J., East Williston, L. I.	Pine's No. 2 Star Raw Bone Super-Phosphate Complete Manure	East Williston	3584
Pulverized Manure Co., The, Chicago, Ill.	Wizard Brand Manure	Buffalo	3388
Pulverized Manure Co., The, Chicago, Ill.	Wizard Brand Manure Pulverized Cattle	Buffalo	3390
Pulverized Manure Co., The, Chicago, Ill.	Wizard Brand Manure Pulverized Sheep	Buffalo	3389
Rasin Monumental Co., Baltimore, Md.	Pure Raw Bone	Delanson	3342
Rasin Monumental Co., Baltimore, Md.	Rasin's Acid Phosphate	Cobleskill	3311
Rasin Monumental Co., Baltimore, Md.	Rasin's Acid Phosphate	Linwood	4469
Rasin Monumental Co., Baltimore, Md.	Rasin's All Crop Guano	Homer	3931

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid.		Potash.
			Available.	Total.	
4201	Guaranteed Found	1.65 1.73	8. 9.22	—— 11.10	5. 5.26
4292	Guaranteed Found	2.47 1.89	—— ——	23. 18.02	—— ——
4148	Guaranteed Found	—— ——	16. 16.71	—— 17.53	—— ——
3802	Guaranteed Found	—— ——	10. 10.13	—— 10.85	8. 7.82
4202	Guaranteed Found	1.65 1.70	8. 9.44	—— 10.98	2. 2.14
4016	Guaranteed Found	—— ——	12. 11.57	—— 12.46	5. 4.98
4291	Guaranteed Found	—— ——	15. *——	17. 16.77	—— ——
3583	Guaranteed Found	3.29 3.45	7. 7.51	8. 8.87	7. 8.16
3584	Guaranteed Found	2.25 2.50	6. 6.55	7. 8.49	3. 3.40
3388	Guaranteed Found	1.8 2.46	1. 1.62	—— 1.66	1. 2.60
3390	Guaranteed Found	1.8 2.01	1. 1.02	—— 1.14	1. 1.66
3389	Guaranteed Found	1.8 2.06	1. 1.14	—— 1.22	1. 2.20
3342	Guaranteed Found	3.70 3.79	—— ——	20.60 21.01	—— ——
3311	Guaranteed Found	—— ——	14. 15.82	15. 16.32	—— ——
4469	Guaranteed Found	—— ——	14. 15.14	15. 16.40	—— ——
3931	Guaranteed Found	.82 .84	8. 8.57	9. 11.51	5. 4.68

* No official method for determining available Phosphoric Acid in this sample.

ANALYSES OF SAMPLES OF FERTILIZERS

NAME AND ADDRESS OF MANUFACTURER OR JOBBER.	Brand or trade name.	Locality where sample was taken.	Number.
Rasin Monumental Co., Baltimore, Md.	Rasin's Bone & Potash Fertilizer	Delanson	3343
Rasin Monumental Co., Baltimore, Md.	Rasin's Empire Guano	Schuylers Lake	4213
Rasin Monumental Co., Baltimore, Md.	Rasin's Genesee Valley Root Manure	Fairport	3980
Rasin Monumental Co., Baltimore, Md.	Rasin's Genuine German Kainit	Cobleskill	3310
Rasin Monumental Co., Baltimore, Md.	Rasin's Gold Standard	Rome	4205
Rasin Monumental Co., Baltimore, Md.	Rasin's High Grade Bone & Potash	Medina	3828
Rasin Monumental Co., Baltimore, Md.	Rasin's Irish Potato Special	Canandaigua	3986
Rasin Monumental Co., Baltimore, Md.	Rasin's I X L Fertilizer	Amsterdam	3679
Rasin Monumental Co., Baltimore, Md.	Rasin's National Crop Compound	Medina	3825
Rasin Monumental Co., Baltimore, Md.	Rasin's Special Fish & Potash Mixture	Cuyler	3937
Rasin Monumental Co., Baltimore, Md.	Rasin's United Grain Grower	Rose	3724
Rasin Monumental Co., Baltimore, Md.	Rasin's Vegetable Special	Amsterdam	3681
Rasin Monumental Co., Baltimore, Md.	Rasin's Wheat & Truck Mixture	Medina	3826
Rasin Monumental Co., Baltimore, Md.	Rasin's X X X Fertilizer	Amsterdam	3680
Reading Bone Fertilizer Co., Reading, Pa.	Alkaline Phosphate and Potash	Hamburg	3379
Reading Bone Fertilizer Co., Reading, Pa.	Blood, Meat & Potash Mixture	Homer	3929

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric Acid. Available.	Phosphoric Acid. Total.	Potash.
3343	Guaranteed Found	—— ——	10. 10.64	11. 12.02	2. 2.14
4213	Guaranteed Found	1.65 1.92	8. 8.50	9. 10.36	2. 2.
3980	Guaranteed Found	.82 .84	8. 8.01	9. 9.61	10. 9.98
3310	Guaranteed Found	—— ——	—— ——	—— ——	12. 12.06
4205	Guaranteed Found	2.47 2.35	6. 6.04	7. 7.94	6. 5.12
3828	Guaranteed Found	—— ——	12. 12.24	13. 13.96	5. 5.52
3986	Guaranteed Found	3.29 3.31	7. 7.81	8. 9.29	8. 8.24
3679	Guaranteed Found	.82 1.09	9. 9.	10. 11.68	3. 3.66
3825	Guaranteed Found	.82 .86	8. 9.09	9. 11.51	4. 4.24
3937	Guaranteed Found	3.29 2.97	6. 6.22	7. 8.32	10. 11.60
3724	Guaranteed Found	.82 .82	8. 9.04	9. 10.82	2. 2.53
3681	Guaranteed Found	1.65 1.63	8. 8.04	9. 10.52	10. 9.98
3826	Guaranteed Found	—— ——	10. 10.28	11. 11.98	8. 8.42
3680	Guaranteed Found	1.65 1.93	8. 7.61	9. 10.34	5. 6.26
3379	Guaranteed Found	—— ——	8. 9.16	9. 9.40	5. 5.54
3929	Guaranteed Found	1.64 1.70	8. 8.17	—— 10.53	2. 2.52

ANALYSES OF SAMPLES OF FERTILIZERS

NAME AND ADDRESS OF MANUFACTURER OR JOBBER.	Brand or trade name.	Locality where sample was taken.	Number.
Reading Bone Fertilizer Co., Reading, Pa.	Farmer's Tankage & Potash for Corn, Grain & Grass	Bergen	3475
Reading Bone Fertilizer Co., Reading, Pa.	Gilt Edge Potato & Tobacco Grower	Bergen	3474
Reading Bone Fertilizer Co., Reading, Pa.	Reading All Crop Special	Bergen	3473
Reading Bone Fertilizer Co., Reading, Pa.	Reading Prize Winner	Hamburg	3380
Reading Bone Fertilizer Co., Reading, Pa.	Reading Ten & Eight	Homer	3930
Reading Bone Fertilizer Co., Reading, Pa.	Tobacco & Truck Special	Hamburg	3382
Reading Bone Fertilizer Co., Reading, Pa.	Truck, Fruit Tree, Vine, Potato & Tobacco Grower	Hamburg	3381
Reichard, Robert A., Allentown, Pa.	Lehigh Potato Manure	Florida	3619
Reichard, Robert A., Allentown, Pa.	Peerless Phosphate	New Hampton	3624
Reichard & Bro., Inc., J. G., Bowers, Pa.	Acid Phosphate 14%	Tioga Centre	4429
Reichard & Bro., Inc., J. G., Bowers, Pa.	Champion Grain Grower	Tioga Centre	4428
Reichard & Bro., Inc., J. G., Bowers, Pa.	Surpass Phosphate	Tioga Centre	4430
Rogers & Hubbard Co., The, Middletown, Conn.	Hubbard's Bone Base Complete Phosphate	Millerton	3889
Rogers & Hubbard Co., The, Middletown, Conn.	Hubbard's Bone Base Oats and Top Dressing	Goshen	2294
Rogers & Hubbard Co., The, Middletown, Conn.	Hubbard's Bone Base Oats and Top Dressing	Hillsdale	3132
Rogers & Hubbard Co., The, Middletown, Conn.	Hubbard's Bone Base Oats and Top Dressing	Schuylerville	4082

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen	Phosphoric acid.		Potash.
			Available.	Total.	
3475	Guaranteed Found	.82 .92	8. 8.39	9. 9.23	4. 4.34
3474	Guaranteed Found	1.64 1.77	7. 7.27	8. 9.65	10. 10.82
3473	Guaranteed Found	1.64 1.44	7. 7.62	8. 8.28	5. 5.56
3380	Guaranteed Found	2.47 3.12	9. 10.15	10. 11.25	12. 12.68
3930	Guaranteed Found	—— ——	10. 9.03	—— 9.70	8. 7.46
3382	Guaranteed Found	2.47 2.44	6. 7.13	7. 9.15	6. 6.34
3381	Guaranteed Found	3.29 3.41	8. 8.23	9. 9.79	7. 6.70
3619	Guaranteed Found	1.64 1.75	8. 8.30	10. 9.50	10. 10.70
3624	Guaranteed Found	.82 .91	8. 8.03	8.50 9.75	4. 4.16
4429	Guaranteed Found	—— ——	14. 15.67	—— 15.95	—— ——
4428	Guaranteed Found	.82 .83	8. 9.03	10. 9.85	4. 4.52
4430	Guaranteed Found	1.64 1.61	8. 9.65	10. 10.87	2. 2.28
3889	Guaranteed Found	1.50 1.51	7. 7.92	8. 9.44	5. 6.30
2294	Guaranteed Found	8.50 *8.63	4.50 7.45	8. 9.67	8. 7.66
3132	Guaranteed Found	8.50 *9.31	4.50 6.34	8. 7.87	8. 8.08
4082	Guaranteed Found	8.50 8.53	4.50 5.87	8. 8.73	8. 7.95

* Incorrectly reported in Bulletin No. 354.

ANALYSES OF SAMPLES OF FERTILIZERS

Name and Address of Manufacturer or Jobber.	Brand or trade name.	Locality where sample was taken.	Number.
Rogers & Hubbard Co., The, Middletown, Conn.	Hubbard's Bone Base Soluble Corn and General Crops Manure	Dormansville	5102
Rogers & Hubbard Co., The, Middletown, Conn.	Hubbard's Bone Base Soluble Tobacco Manure	Dormansville	5103
Royster Guano Co., F. S., Baltimore, Md.	Nitrate of Soda	Fruitland	3750
Royster Guano Co., F. S., Baltimore, Md.	Royster's Ammoniated Potash Compound	Medina	3813
Royster Guano Co., F. S., Baltimore, Md.	Royster's Ammoniated Superphosphate for Corn	Whitehall	4093
Royster Guano Co., F. S., Baltimore, Md.	Royster's Big Yield Potato Producer	Attica	3493
Royster Guano Co., F. S., Baltimore, Md.	Royster's Bumper Crop Phosphate	Little Valley	4300
Royster Guano Co., F. S., Baltimore, Md.	Royster's Challenge Complete Compound	Caywood	4704
Royster Guano Co., F. S., Baltimore, Md.	Royster's Champion Crop Compound	Medina	3816
Royster Guano Co., F. S., Baltimore, Md.	Royster's Complete Potato Manure	Falconer	3284
Royster Guano Co., F. S., Baltimore, Md.	Royster's Corn & Hop Special Fertilizer	Cincinnatus	3911
Royster Guano Co., F. S., Baltimore, Md.	Royster's Fish, Flesh & Fowl	Batavia	3490
Royster Guano Co., F. S., Baltimore, Md.	Royster's 14% Acid Phosphate	Cobleskill	3320
Royster Guano Co., F. S., Baltimore, Md.	Royster's Good Cheer Brand	Glen Cove	3591
Royster Guano Co., F. S., Baltimore, Md.	Royster's Great Grain Grower	Tully	3543
Royster Guano Co., F. S., Baltimore, Md.	Royster's Harvest King Fertilizer	Wales Center	3269

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid. Available.	Phosphoric acid. Total.	Potash.
5102	Guaranteed Found	2.50 2.95	6. 7.48	8. 8.71	8. 8.08
5103	Guaranteed Found	5. 5.10	7. 7.69	10. 11.12	10. 10.80
3750	Guaranteed Found	15. 15.54	—— ——	—— ——	—— ——
3813	Guaranteed Found	.82 .92	9. 8.28	9.50 9.99	7. 6.63
4093	Guaranteed Found	2.47 2.56	9. 9.91	9.5 10.87	2. 2.84
3493	Guaranteed Found	1.65 1.67	5. 5.65	5.50 6.27	10. 10.32
4300	Guaranteed Found	—— ——	8. 8.35	8.50 9.05	5. 5.02
4704	Guaranteed Found	1.65 1.67	8. 7.47	8.50 8.46	6. 5.77
3816	Guaranteed Found	1.65 1.72	8. 7.79	8.50 8.97	4. 3.95
3284	Guaranteed Found	3.29 3.27	6. 6.59	6.50 7.99	10. 9.67
3911	Guaranteed Found	2.08 2.31	8. 8.47	8.50 9.87	3. 3.64
3490	Guaranteed Found	1.65 1.66	8. 7.38	8.50 9.13	3. 3.02
3320	Guaranteed Found	—— ——	14. 14.81	14.50 15.37	—— ——
3591	Guaranteed Found	1.03 1.22	8. 8.44	8.50 9.60	2. 2.26
3543	Guaranteed Found	.82 .90	8. 8.28	8.50 9.18	5. 5.26
3269	Guaranteed Found	1.65 1.64	8. 7.31	8.50 8.59	2. 4.51

ANALYSES OF SAMPLES OF FERTILIZERS

Name and Address of Manufacturer or Jobber.	Brand or trade name.	Locality where sample was taken.	Number.
Royster Guano Co., F. S., Baltimore, Md.	Royster's High Grade Acid Phosphate	Florida	3618
Royster Guano Co., F. S., Baltimore, Md.	Royster's High Grade Corn Fertilizer	Falconer	3285
Royster Guano Co., F. S., Baltimore, Md.	Royster's High Grade Potash Mixture	Falconer	3286
Royster Guano Co., F. S., Baltimore, Md.	Royster's High Grade Potato Grower	Medina	3814
Royster Guano Co., F. S., Baltimore, Md.	Royster's Imperial Formula	Medina	3817
Royster Guano Co., F. S., Baltimore, Md.	Royster's Lawn & Meadow Formula	Gasport	3848
Royster Guano Co., F. S., Baltimore, Md.	Royster's Peerless Grain and Grass Grower	Wales Center	3268
Royster Guano Co., F. S., Baltimore, Md.	Royster's Practical Truck Manure	Farmingdale	3582
Royster Guano Co., F. S., Baltimore, Md.	Royster's Prolific Potato Producer	Pine Island	3621
Royster Guano Co., F. S., Baltimore, Md.	Royster's Pure Ground Bone Meal	Medina	3819
Royster Guano Co., F. S., Baltimore, Md.	Royster's Royal Special Potato Guano	Medina	3818
Royster Guano Co., F. S., Baltimore, Md.	Royster's Seeding Down Special Fertilizer	Plattsburgh	3765
Royster Guano Co., F. S., Baltimore, Md.	Royster's Special Celery and Onion Guano	Warsaw	4458
Royster Guano Co., F. S., Baltimore, Md.	Royster's Special Fruit and Crop Grower	Medina	3815
Royster Guano Co., F. S., Baltimore, Md.	Royster's Superior Potash Mixture	Merrifield	4030
Royster Guano Co., F. S., Baltimore, Md.	Royster's Supreme Potato and Cabbage Special	Tully	3542
Royster Guano Co., F. S., Baltimore, Md.	Royster's Truckers Favorite	Riverhead	4165

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid. Available.	Phosphoric acid. Total.	Potash.
3618	Guaranteed	——	16.	16.50	——
	Found	——	16.49	16.87	——
3285	Guaranteed	1.65	7.	7.50	5.
	Found	1.68	7.36	8.02	5.42
3286	Guaranteed	——	10.	10.50	10.
	Found	——	10.89	11.55	9.49
3814	Guaranteed	2.47	6.	6.50	10.
	Found	2.27	6.18	6.96	10.14
3817	Guaranteed	.82	8.	8.50	4.
	Found	.79	8.18	9.12	4.04
3848	Guaranteed	4.11	6.	6.50	2.
	Found	3.69	7.31	8.73	2.78
3268	Guaranteed	——	10.	10.50	2.
	Found	——	10.67	11.27	1.92
3582	Guaranteed	2.47	8.	8.50	6.
	Found	2.58	8.65	9.93	6.26
3621	Guaranteed	1.23	6.	6.50	5.
	Found	1.30	6.29	7.43	5.14
3819	Guaranteed	3.29	——	20.60	——
	Found	4.18	——	20.96	——
3818	Guaranteed	4.11	7.	7.50	7.
	Found	3.08	7.14	8.71	5.99
3765	Guaranteed	.82	9.	9.50	3.
	Found	.96	8.75	9.79	3.50
4458	Guaranteed	3.29	8.	8.50	12.
	Found	3.21	8.38	9.44	13.06
3815	Guaranteed	——	10.	10.50	8.
	Found	——	10.38	11.64	7.94
4030	Guaranteed	——	12.	12.50	5.
	Found	——	12.94	13.42	4.98
3542	Guaranteed	1.65	8.	8.50	10.
	Found	1.68	8.33	9.63	10.24
4165	Guaranteed	4.94	8.	8.50	5.
	Found	4.52	8.74	10.48	5.28

ANALYSES OF SAMPLES OF FERTILIZERS

NAME AND ADDRESS OF MANUFACTURER OR JOBBER.	Brand or trade name.	Locality where sample was taken.	Number.
Royster Guano Co., F. S., Baltimore, Md.	Royster's Universal Truck Fertilizer	Sodus	3707
Royster Guano Co., F. S., Baltimore, Md.	Royster's Wheat, Oats & Barley Fertilizer	Wales Center	3267
Royster Guano Co., F. S., Baltimore, Md.	Royster's XX Acid Phosphate	Fultonville	4951
Sander, Adam, Salamanca, N. Y.	Dry Tankage	Salamanca	5002
Sanderson Fertilizer & Chem. Co., New Haven, Conn.	Riverhead T'wn Agri. Society Fertilizer 1913, Formula No. 2	Riverhead	3599
Sanderson Fertilizer & Chem. Co., New Haven, Conn.	Riverhead T'wn Agri. Society Fertilizer 1913, Formula No. 3	Riverhead	3600
Sanderson Fertilizer & Chem. Co., New Haven, Conn.	Sanderson's Cabbage Fertilizer	Mineola	3587
Sanderson Fertilizer & Chem. Co., New Haven, Conn.	Sanderson's Special Potato Manure	Jamaica	3595
Schaal-Sheldon Fertilizer Co., Buffalo, N. Y.	Complete Fertilizer with Extra Potash	Collins	3353
Schaal-Sheldon Fertilizer Co., Buffalo, N. Y.	Dissolved Phosphate	Collins	3370
Schaal-Sheldon Fertilizer Co., Buffalo, N. Y.	Dissolved Phosphate with Extra Potash	Collins Center	4283
Schaal-Sheldon Fertilizer Co., Buffalo, N. Y.	Empire	Cherry Creek	4278
Schaal-Sheldon Fertilizer Co., Buffalo, N. Y.	Farmer's Favorite	Collins	3373
Schaal-Sheldon Fertilizer Co., Buffalo, N. Y.	Fruit and Vine Fertilizer	Eden Center	3368
Schaal-Sheldon Fertilizer Co., Buffalo, N. Y.	Grain and Grass Fertilizer	Collins	3374
Schaal-Sheldon Fertilizer Co., Buffalo, N. Y.	Guano	Collins	3372

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric Acid. Available.	Phosphoric Acid. Total.	Potash.
3707	Guaranteed Found	3.29 2.90	8. 7.83	8.50 9.72	7. 7.90
3267	Guaranteed Found	.82 .94	8. 8.07	8.50 9.31	2. 2.32
4951	Guaranteed Found	—— ——	12. 12.17	12.50 12.60	—— ——
5002	Guaranteed Found	—— 4.21	—— ——	—— 21.35	—— ——
3599	Guaranteed Found	4.94 4.72	8. 8.24	—— 9.68	5. 5.08
3600	Guaranteed Found	4.11 3.42	8. 8.18	—— 9.	8. 8.84
3587	Guaranteed Found	4. 3.99	5. 6.50	—— 8.62	5. 4.87
3595	Guaranteed Found	3.30 3.13	7. 8.79	8. 9.11	7. 8.09
3353	Guaranteed Found	1.65 1.70	8. 7.32	9. 9.10	10. 10.18
3370	Guaranteed Found	—— ——	14 13.84	15. 14.26	—— ——
4283	Guaranteed Found	—— ——	10. 9.56	11. 9.94	4. 4.12
4278	Guaranteed Found	.82 .91	7. 7.50	8. 8.42	1. 1.52
3373	Guaranteed Found	.82 .92	8. 8.69	9. 9.59	2. 2.10
3368	Guaranteed Found	2.47 2.55	6. 6.39	7. 7.69	10. 9.92
3374	Guaranteed Found	1.23 1.38	8. 8.35	9. 9.49	7. 7.32
3372	Guaranteed Found	.82 .93	8. 8.30	9. 9.28	4. 4.16

ANALYSES OF SAMPLES OF FERTILIZERS

NAME AND ADDRESS OF MANUFACTURER OR JOBBER.	Brand or trade name.	Locality where sample was taken.	Number.
Schaal-Sheldon Fertilizer Co., Buffalo, N. Y.	High Grade Ground Bone	Eden Center	3365
Schaal-Sheldon Fertilizer Co., Buffalo, N. Y.	Muriate of Potash	Barker	4310
Schaal-Sheldon Fertilizer Co., Buffalo, N. Y.	Schaal's Corn and Potato	Eden Center	3364
Schaal-Sheldon Fertilizer Co., Buffalo, N. Y.	Schaal's Standard	Boston	5011
Schaal-Sheldon Fertilizer Co., Buffalo, N. Y.	Superior	Eden Center	3366
Schaal-Sheldon Fertilizer Co., Buffalo, N. Y.	Ten and Eight	Collins	3371
Schaal-Sheldon Fertilizer Co., Buffalo, N. Y.	Truckers' Manure	Cherry Creek	4279
Shafer Co., Perry C., Brockport, N. Y.	Shafer's Special Fertilizer	Brockport	3463
Shay Fertilizer Co., C. M., Groton, Conn.	Shay's Potato Manure	Orient	4180
Shoemaker & Co., Ltd., M. L., Philadelphia, Pa.	Swift-Sure Bone Meal	Southampton	4191
Shoemaker & Co., Ltd., M. L., Philadelphia, Pa.	Swift-Sure Guano for Truck, Corn & Onion	Southampton	4192
Stappenbeck & Sons, H., Utica, N. Y.	Animal Bone and Potash	Clinton	4208
Stappenbeck Bros., Rochester, N. Y.	Concentrated Tankage	Rochester	4508
Sterling Chemical Co., Cambridge, Mass.	"Sterlingworth" Concentrated Plant Food	Rochester	3458
Stevens, Geo., Petersborough, Ont., Can.	Hardwood Ashes	Lancaster	3392
Stockwell Co., Inc., J. W., Fillmore, N. Y.	Stockwell Co.'s Home Mixed 4-8-8 Fertilizer	Fillmore	4328

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid.		Potash.
			Available.	Total.	
3365	Guaranteed Found	3.29 2.91	—— ——	20.59 20.65	—— ——
4310	Guaranteed Found	—— ——	—— ——	—— ——	49. 49.30
3364	Guaranteed Found	1.65 1.72	8. 7.10	9. 9.11	4. 5.22
5011	Guaranteed Found	1.65 1.63	8. 7.45	9. 8.63	2. 2.95
3366	Guaranteed Found	.82 .97	7. 7.74	8. 8.62	9. 9.58
3371	Guaranteed Found	—— ——	10. 10.33	11. 10.63	8. 7.94
4279	Guaranteed Found	2.47 1.93	8. 7.47	9. 9.05	6. 5.10
3463	Guaranteed Found	2.06 2.06	8. 8.01	9. 9.31	5. 5.58
4180	Guaranteed Found	3.28 3.53	—— 8.51	8. 9.90	7. 5.41
4191	Guaranteed Found	4.53 5.33	—— ——	20. 23.03	—— ——
4192	Guaranteed Found	1.65 1.87	8. 10.21	—— 11.83	5. 5.30
4208	Guaranteed Found	2. 2.17	8. 13.56	16. 19.90	3.50 4.40
4508	Guaranteed Found	9. 8.23	—— ——	6. 10.18	—— ——
3458	Guaranteed Found	6. 9.27	—— 12.31	—— 12.33	—— ——
3392	Guaranteed Found	—— ——	—— ——	—— 1.60	—— 3.
4328	Guaranteed Found	3.29 3.25	8. 8.80	—— 9.12	8. 8.04

ANALYSES OF SAMPLES OF FERTILIZERS

NAME AND ADDRESS OF MANUFACTURER OR JOBBER.	Brand or trade name.	Locality where sample was taken.	Number.
Stockwell Co., Inc., J. W., Fillmore, N. Y.	Stockwell Co.'s Home Mixed 1-10-10 Fertilizer	Fillmore	4325
Stockwell Co., Inc., J. W., Fillmore, N. Y.	Stockwell Co.'s Home Mixed 2-8-10 Fertilizer	Fillmore	4326
Stockwell Co., Inc., J. W., Fillmore, N. Y.	Stockwell Co.'s Home Mixed 2-10½-6 Fertilizer	Fillmore	4327
Stumpp & Walter Co., New York, N. Y.	Emerald Lawn Dressing	New York	4606
Stumpp & Walter Co., New York, N. Y.	S. & W. Co.'s Bone Fertilizer	New York	4607
Swift & Company, Chicago, Ill.	Muriate of Potash	Hamlin	3975
Swift & Company, Chicago, Ill.	Nitrate of Soda	Hamlin	3976
Swift & Company, Chicago, Ill.	Swift's Animal Bone Fertilizer, Young Bros. Formula No. 1, 6-8-5	Aquebogue	4196
Swift & Company, Chicago, Ill.	Swift's Animal Bone Fertilizer, Young Bros. Formula No. 2, 5-8-8	Aquebogue	4197
Swift & Company, Chicago, Ill.	Swift's Early Potato & Vegetable Grower	Hicksville	3552
Swift & Company, Chicago, Ill.	Swift's Grain Fertilizer	Eden Center	3362
Swift & Company, Chicago, Ill.	Swift's Ground Dried Blood	Hamlin	3971
Swift & Company, Chicago, Ill.	Swift's High Grade Market Garden Manure	Hicksville	3553
Swift & Company, Chicago, Ill.	Swift's Pulverized Sheep Manure	Falconer	3278
Swift & Company, Chicago, Ill.	Swift's Pure Bone Meal	Falconer	3277

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid. Available.	Phosphoric acid. Total.	Potash.
4325	Guaranteed	.82	10.	——	10.
	Found	.89	10.95	11.31	10.28
4326	Guaranteed	1.65	8.	——	10.
	Found	1.64	8.96	9.44	10.04
4327	Guaranteed	1.65	10.25	——	6.
	Found	1.95	10.59	11.05	6.86
4606	Guaranteed	3.	5.	7.	6.
	Found	2.98	7.59	8.87	6.22
4607	Guaranteed	3.	——	20.	——
	Found	3.02	——	26.51	——
3975	Guaranteed	——	——	——	50.
	Found	——	——	——	50.14
3976	Guaranteed	14.81	——	——	——
	Found	15.24	——	——	——
4196	Guaranteed	4.94	8.	9.	5.
	Found	4.26	8.28	8.80	5.22
4197	Guaranteed	4.10	8.	9.	8.
	Found	3.97	9.01	9.31	7.68
3552	Guaranteed	3.29	6.	7.	10.
	Found	3.29	7.13	8.01	9.07
3362	Guaranteed	.82	8.	9.	2.
	Found	.94	8.56	9.44	1.92
3971	Guaranteed	13.18	——	——	——
	Found	13.72	——	——	——
3553	Guaranteed	3.29	8.	9.	7.
	Found	2.98	8.36	8.76	7.60
3278	Guaranteed	2.06	——	1.50	1.50
	Found	2.22	——	1.60	2.54
3277	Guaranteed	2.47	——	24.	——
	Found	2.45	——	24.48	——

ANALYSES OF SAMPLES OF FERTILIZERS

Name and Address of Manufacturer or Jobber.	Brand or trade name.	Locality where sample was taken.	Number.
Swift & Company, Chicago, Ill.	Swift's Pure Diamond B Fertilizer	Falconer	3274
Swift & Company, Chicago, Ill.	Swift's Pure Diamond C Fertilizer	Oriskany Falls	3673
Swift & Company, Chicago, Ill.	Swift's Pure Diamond D Fertilizer	West Coxsackie	3898
Swift & Company, Chicago, Ill.	Swift's Pure Diamond E Fertilizer	Oxford	4108
Swift & Company, Chicago, Ill.	Swift's Pure Diamond F Fertilizer	Oxford	4109
Swift & Company, Chicago, Ill.	Swift's Pure Diamond G Fertilizer	Hamlin	3974
Swift & Company, Chicago, Ill.	Swift's Pure Diamond H Fertilizer	Owego	4415
Swift & Company, Chicago, Ill.	Swift's Pure Florist Special Tankage	Lancaster	3393
Swift & Company, Chicago, Ill.	Swift's Pure Garden City Acid Phosphate	Union	4669
Swift & Company, Chicago, Ill.	Swift's Pure Garden City Phosphate	Sodus	3456
Swift & Company, Chicago, Ill.	Swift's Pure German Kainit	Cortland	3948
Swift & Company, Chicago, Ill.	Swift's Pure Onion, Potato & Tobacco Fertilizer	Hamlin	3972
Swift & Company, Chicago, Ill.	Swift's Pure Potato, Celery & Onion Grower	Collins	3351
Swift & Company, Chicago, Ill.	Swift's Pure Prolific Guano	Addison	4498
Swift & Company, Chicago, Ill.	Swift's Pure Special High Grade Acid Phosphate	Union	3548
Swift & Company, Chicago, Ill.	Swift's Pure Special Potato Fertilizer	Falconer	3275

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid.		Potash.
			Available.	Total.	
3274	Guaranteed Found	2.47 2.44	8. 8.91	9. 10.57	5. 5.47
3673	Guaranteed Found	1.65 1.53	8. 8.15	9. 8.65	4. 4.04
3898	Guaranteed Found	2.41 2.21	6. 5.76	7. 6.04	10. 10.68
4108	Guaranteed Found	3.29 3.	8. 8.95	9. 9.19	7. 6.41
4109	Guaranteed Found	—— ——	8. 7.20	9. 7.56	3. 2.79
3974	Guaranteed Found	—— ——	10. 9.77	11. 10.72	8. 7.61
4415	Guaranteed Found	—— ——	12. 11.55	13. 12.25	5. 5.10
3393	Guaranteed Found	4.94 5.40	—— ——	11.44 13.69	—— ——
4669	Guaranteed Found	—— ——	14. 14.11	15. 14.31	—— ——
3456	Guaranteed Found	—— ——	14. 14.40	—— 15.48	—— ——
3948	Guaranteed Found	—— ——	—— ——	—— ——	12. 11.80
3972	Guaranteed Found	1.65 1.63	8. 8.38	9. 9.18	7. 7.14
3351	Guaranteed Found	.82 .92	5. 5.49	5.50 6.01	10. 9.70
4498	Guaranteed Found	.41 .53	8. 8.11	9. 8.93	2. 2.34
3548	Guaranteed Found	—— ——	16. 15.35	17. 15.50	—— ——
3275	Guaranteed Found	1.65 1.63	8. 8.62	9. 9.52	10. 10.56

ANALYSES OF SAMPLES OF FERTILIZERS

NAME AND ADDRESS OF MANUFACTURER OR JOBBER.	Brand or trade name.	Locality where sample was taken.	Number.
Swift & Company, Chicago, Ill.	Swift's Pure Superphosphate	Falconer	3273
Swift & Company, Chicago, Ill.	Swift's Pure Truck Grower	Falconer	3276
Swift & Company, Chicago, Ill.	Swift's Raw Bone Meal	Cortland	3949
Swift & Company, Chicago, Ill.	Swift's Red Steer	Oriskany Falls	3675
Swift & Company, Chicago, Ill.	Swift's Special Phosphate & Potash	Esperance	3341
Swift & Company, Chicago, Ill.	Swift's Special Tobacco Fertilizer	Apalachin	4420
Syracuse Rendering Co., Syracuse, N. Y.	Syracuse Animal Brand	Willet	3919
Syracuse Rendering Co., Syracuse, N. Y.	Syracuse Ground Bone	North Collins	3293
Syracuse Rendering Co., Syracuse, N. Y.	Syracuse Gypsy Brand	North Collins	3292
Syracuse Rendering Co., Syracuse, N. Y.	Syracuse Indian Brand for Corn & Wheat	Marcellus	3520
Syracuse Rendering Co., Syracuse, N. Y.	Syracuse Market Garden Manure	Burns	4044
Syracuse Rendering Co., Syracuse, N. Y.	Syracuse Onondaga Brand	North Collins	3294
Syracuse Rendering Co., Syracuse, N. Y.	Syracuse Potato Manure	Knowlesville	3835
Syracuse Rendering Co., Syracuse, N. Y.	Syracuse Seneca Brand	Willet	3918
Syracuse Rendering Co., Syracuse, N. Y.	Syracuse Special for Celery, Cabbage and Potatoes	Marcellus	3518
Syracuse Rendering Co., Syracuse, N. Y.	Syracuse Superphosphate	Lockport	3806

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid.		Potash.
			Available.	Total.	
3273	Guaranteed	1.65	8.	9.	2.
	Found	1.66	8.96	9.76	2.16
3276	Guaranteed	.82	8.	8.50	4.
	Found	.85	7.02	7.60	6.45
3949	Guaranteed	3.70	——	23.	——
	Found	4.03	——	23.58	——
3675	Guaranteed	1.65	8.	9.	2.
	Found	1.41	8.15	8.59	2.89
3341	Guaranteed	——	10.	11.	2.
	Found	——	10.43	11.35	1.92
4420	Guaranteed	4.50	3.	4.	5.50
	Found	4.44	3.60	4.02	6.90
3919	Guaranteed	2.46	8.	9.	4.
	Found	2.62	8.16	10.18	4.92
3293	Guaranteed	2.46	——	23.	——
	Found	2.48	——	26.66	——
3292	Guaranteed	——	10.	——	8.
	Found	——	10.39	10.63	8.16
3520	Guaranteed	1.64	8.	9.	4.
	Found	1.74	8.15	9.85	4.18
4044	Guaranteed	3.28	7.	8.	8.
	Found	3.07	8.25	8.99	8.88
3294	Guaranteed	.82	8.	9.	4.
	Found	.84	8.13	9.19	4.40
3835	Guaranteed	2.46	8.	9.	6.
	Found	2.45	8.86	10.78	6.86
3918	Guaranteed	1.24	8.	9.	4.
	Found	1.49	8.17	9.63	4.64
3518	Guaranteed	1.24	7.	8.	9.
	Found	1.28	7.31	8.79	9.06
3806	Guaranteed	.82	7.	8.	2.
	Found	.91	6.58	7.32	2.04

ANALYSES OF SAMPLES OF FERTILIZERS

NAME AND ADDRESS OF MANUFACTURER OR JOBBER.	Brand or trade name.	Locality where sample was taken.	Number.
Thomas & Son Co., I. P., Philadelphia, Pa.	Farmers' Choice Phosphate	Wading River	4152
Thomas & Son Co., I. P., Philadelphia, Pa.	Northport Farmers Club 5-8-7	Northport	4604
Thomas & Son Co., I. P., Philadelphia, Pa.	Northport Farmers Club 6-8-5	Northport	4605
Thomas & Son Co., I. P., Philadelphia, Pa.	Thomas' Long Island Special 4-8-7	Hempstead	3579
Thomas & Son Co., I. P., Philadelphia, Pa.	Thomas' Truck & Potato Fertilizer	Hempstead	3578
Thomas & Son Co., I. P., Philadelphia, Pa.	Trucker's High Grade Guano	Wading River	4153
Thomson & Sons, Ltd., Wm., Clovenfords, Scotland	Thomson's "Special" Chrysanthemum Manure	New York	4624
Thomson & Sons, Ltd., Wm., Clovenfords, Scotland	Thomson's Vine Plant and Vegetable Manure	New York	4623
Thorburn & Co., J. M., New York, N. Y.	Thorburn's Complete Manure	New York	4611
Thorburn & Co., J. M., New York, N. Y.	Thorburn's Lawn Fertilizer	New York	4612
Tunnell & Co., Inc., F. W., Philadelphia, Pa.	F. W. Tunnell & Co.'s Bone, Blood & Potash	Riverhead	4198
Tunnell & Co., Inc., F. W., Philadelphia, Pa.	F. W. Tunnell & Co.'s New York Potato & Truck Manure	Hicksville	3569
Tunnell & Co., Inc., F. W., Philadelphia, Pa.	F. W. Tunnell & Co.'s Royal Fish Guano	Hicksville	3570
Tuscarora Fertilizer Co., Baltimore, Md.	Ground Tankage	Silver Creek	4260
Tuscarora Fertilizer Co., Baltimore, Md.	High Grade Dried Blood	Silver Creek	4261
Tuscarora Fertilizer Co., Baltimore, Md.	Muriate of Potash	Silver Creek	4259

COLLECTED IN NEW YORK STATE IN 1913.

Number.		POUNDS IN 100 POUNDS OF FERTILIZER.			
		Nitrogen.	Phosphoric acid. Available.	Phosphoric acid. Total.	Potash.
4152	Guaranteed	1.6	9.50	——	2.
	Found	1.74	10.82	11.16	2.08
4604	Guaranteed	4.11	8.	9.	7.
	Found	4.50	9.61	10.63	7.06
4605	Guaranteed	4.93	8.	9.	5.
	Found	5.07	8.91	9.85	6.68
3579	Guaranteed	3.25	8.	——	7.
	Found	3.39	8.89	9.83	7.04
3578	Guaranteed	4.11	7.	8.	8.
	Found	4.15	8.09	8.93	8.52
4153	Guaranteed	3.29	7.	8.	7.
	Found	3.31	8.42	8.96	7.30
4624	Guaranteed	4.25	6.30	——	3.
	Found	5.18	9.20	11.04	5.45
4623	Guaranteed	3.25	7.50	10.5	5.
	Found	3.87	9.42	12.70	7.21
4611	Guaranteed	2.47	6.	7.	6.
	Found	2.61	6.59	9.35	6.42
4612	Guaranteed	4.94	8.	9.	5.
	Found	4.89	8.64	9.38	6.30
4198	Guaranteed	4.12	8.	9.	7.
	Found	3.17	9.23	9.68	7.96
3569	Guaranteed	3.3	8.	9.	7.
	Found	3.03	6.78	7.52	7.82
3570	Guaranteed	2.	7.	9.	3.
	Found	2.14	7.33	8.27	5.21
4260	Guaranteed	7.40	——	6.87	——
	Found	7.69	——	9.86	——
4261	Guaranteed	13.15	——	——	——
	Found	13.14	——	——	——
4259	Guaranteed	——	——	——	48.
	Found	——	——	——	50.50

ANALYSES OF SAMPLES OF FERTILIZERS

Name and Address of Manufacturer or Jobber.	Brand or trade name.	Locality where sample was taken.	Number.
Tuscarora Fertilizer Co., Baltimore, Md.	Nitrate of Soda	Wayland	4719
Tuscarora Fertilizer Co., Baltimore, Md.	Tuscarora Acid Phosphate	Silver Creek	3400
Tuscarora Fertilizer Co., Baltimore, Md.	Tuscarora Ammoniated Phosphate	Wayland	4718
Tuscarora Fertilizer Co., Baltimore, Md.	Tuscarora Animal Bone	Silver Creek	3397
Tuscarora Fertilizer Co., Baltimore, Md.	Tuscarora Big 4 Four	Cincinnatus	3923
Tuscarora Fertilizer Co., Baltimore, Md.	Tuscarora Fruit & Potato	Cincinnatus	3921
Tuscarora Fertilizer Co., Baltimore, Md.	Tuscarora High Grade	Cincinnatus	3924
Tuscarora Fertilizer Co., Baltimore, Md.	Tuscarora Phosphate and Potash	Cincinnatus	3925
Tuscarora Fertilizer Co., Baltimore, Md.	Tuscarora Special Crop Grower	Wayland	4717
Tuscarora Fertilizer Co., Baltimore, Md.	Tuscarora Special Potato Grower	Silver Creek	4258
Tuscarora Fertilizer Co., Baltimore, Md.	Tuscarora Standard	Berkshire	4421
Tuscarora Fertilizer Co., Baltimore, Md.	Tuscarora Truckers Special	Granville	4074
Tuscarora Fertilizer Co., Baltimore, Md.	Tuscarora York State Special	Salem	4076
Tygert Co., The, J. E., Philadelphia, Pa.	Tygert's Special Potato and Tobacco Fertilizer	Calverton	4170
United States Fertilizer Co., The, Baltimore, Md.	Farm Bell Acid Phosphate	Canaseraga	4324
United States Fertilizer Co., The, Baltimore, Md.	Farm Bell Animal Ammoniated	Williamson	3739
United States Fertilizer Co., The, Baltimore, Md.	Farm Bell Buckeye Guano	Elmira	4716

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen	Phosphoric acid. Available.	Phosphoric acid. Total.	Potash.
4719	Guaranteed	14.70	——	——	——
	Found	15.14	——	——	——
3400	Guaranteed	——	14.	14.5	——
	Found	——	15.37	16.29	——
4718	Guaranteed	.82	7.	7.50	1.
	Found	1.11	7.99	8.47	1.22
3397	Guaranteed	2.47	——	22.50	——
	Found	2.88	——	22.73	——
3923	Guaranteed	1.65	7.	7.50	4.
	Found	1.53	7.04	8.16	4.12
3921	Guaranteed	1.65	8.	8.50	10.
	Found	1.67	7.95	8.59	10.66
3924	Guaranteed	——	10.	10.50	8.
	Found	——	10.29	11.09	8.72
3925	Guaranteed	——	10.	10.50	2.
	Found	——	10.62	11.42	4.33
4717	Guaranteed	.82	8.	8.50	2.
	Found	.96	7.96	9.48	2,48
4258	Guaranteed	3.29	8.	8.5	7.
	Found	3.27	8.47	9.49	7.26
4421	Guaranteed	1.65	8.	8.50	2.
	Found	1.66	7.70	9.29	2.40
4074	Guaranteed	3.29	6.	6.50	10.
	Found	3.25	5.93	6.55	11.28
4076	Guaranteed	.82	8.	8.50	4.
	Found	.95	7.68	8.70	3.60
4170	Guaranteed	3.29	6.	7.	8.
	Found	3.31	6.72	7.78	8.04
4324	Guaranteed	——	14.	15.	——
	Found	——	15.34	16.54	——
3739	Guaranteed	1.65	8.	9.	5.
	Found	1.70	8.49	9.21	7.21
4716	Guaranteed	.82	8.	9.	2.
	Found	1.14	11.33	11.53	2.24

ANALYSES OF SAMPLES OF FERTILIZERS

Name and Address of Manufacturer or Jobber.	Brand or trade name.	Locality where sample was taken.	Number.
United States Fertilizer Co., The, Baltimore, Md.	Farm Bell Celery Compound	Williamson	3742
United States Fertilizer Co., The, Baltimore, Md.	Farm Bell Crop Grower	Elmira	4493
United States Fertilizer Co., The, Baltimore, Md.	Farm Bell Excelsior Guano	Williamson	3736
United States Fertilizer Co., The, Baltimore, Md.	Farm Bell Fruit & Grain Grower	Canaseraga	4323
United States Fertilizer Co., The, Baltimore, Md.	Farm Bell Fruit & Potato Guano	Almond	4297
United States Fertilizer Co., The, Baltimore, Md.	Farm Bell German Kainit	Arkport	4046
United States Fertilizer Co., The, Baltimore, Md.	Farm Bell Pennant Winner	Williamson	3734
United States Fertilizer Co., The, Baltimore, Md.	Farm Bell Phospho Pottasso	Almond	4298
United States Fertilizer Co., The, Baltimore, Md.	Farm Bell Potato Special	Burns	4045
United States Fertilizer Co., The, Baltimore, Md.	Farm Bell Wheat, Oat, Corn Special	Stanley	4512
Van Iderstine Co., The, Long Island City, N. Y.	Van Iderstine's Pure Ground Bone	Long Island City	4629
Vaughan's Seed Store, New York, N. Y.	Vaughan's Lawn & Garden	New York	4609
Vaughan's Seed Store, New York, N. Y.	Vaughan's Rams Head Brand Pulverized Sheep Manure	Syracuse	4651
Vaughan's Seed Store, New York, N. Y.	Vaughan's Rose Grower Bone Meal	New York	4608
Weeber & Don, New York, N. Y.	Weeber & Don's Lawn Invigorator	New York	4610
Weiss, George, New York, N. Y.	Fer-til-lo	New York	4628

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid. Available.	Phosphoric acid. Total.	Potash.
3742	Guaranteed Found	3.28 3.31	8. 8.26	9. 8.58	12. 12.32
4493	Guaranteed Found	2.05 2.07	8. 8.76	9. 8.98	3. 3.62
3736	Guaranteed Found	3.28 3.32	8. 8.84	9. 9.46	7. 6.73
4323	Guaranteed Found	—— ——	10. 11.77	11. 11.83	8. 6.49
4297	Guaranteed Found	1.65 1.67	8. 8.62	9. 9.66	10. 10.20
4046	Guaranteed Found	—— ——	—— ——	—— ——	12.50 13.62
3734	Guaranteed Found	.82 1.26	8. 9.01	9. 9.65	4. 4.60
4298	Guaranteed Found	—— ——	12. 12.85	13. 13.07	5. 5.42
4045	Guaranteed Found	3.28 3.18	6. 6.76	7. 7.30	10. 10.92
4512	Guaranteed Found	.82 1.06	8. 8.48	9. 8.88	6. 6.84
4629	Guaranteed Found	2. 2.10	—— ——	27. 28.98	—— ——
4609	Guaranteed Found	2.88 2.68	8. 8.08	—— 10.26	4. 4.32
4651	Guaranteed Found	2. 2.19	1. 1.08	1.20 1.16	1. 1.86
4608	Guaranteed Found	3.70 3.96	—— ——	22. 21.87	—— ——
4610	Guaranteed Found	2.47 2.14	—— ——	3.50 3.98	2.50 2.76
4628	Guaranteed Found	5. 6.93	.7 2.92	—— 12.29	3.5 4.54

ANALYSES OF SAMPLES OF FERTILIZERS

Name and Address of Manufacturer or Jobber.	Brand or trade name.	Locality where sample was taken.	Number.
Wilcox Fertilizer Co., The, Mystic, Conn.	Kainit	Orient Point	4181
Wilcox Fertilizer Co., The, Mystic, Conn.	Wilcox Cauliflower Fertilizer	Greenport	4183
Wilcox Fertilizer Co., The, Mystic, Conn.	Wilcox Fish & Potash	Riverhead	4164
Wilcox Fertilizer Co., The, Mystic, Conn.	Wilcox Fish Guano	Southold	4177
Wilcox Fertilizer Co., The, Mystic, Conn.	Wilcox 4-8-10 Fertilizer	Greenport	4182
Wilcox Fertilizer Co., The, Mystic, Conn.	Wilcox Long Island Dry Ground Fish	Calverton	4173
Wilcox Fertilizer Co., The, Mystic, Conn.	Wilcox Potato Onion & Vegetable Phosphate	Greenport	4184
Wilcox Fertilizer Co., The, Mystic, Conn.	Wilcox Pure Ground Bone	Greenport	4185
(No Manufacturer given)	Sheep Manure	Orleans	4486

COLLECTED IN NEW YORK STATE IN 1913.

Number.		Pounds in 100 Pounds of Fertilizer.			
		Nitrogen.	Phosphoric acid. Available.	Phosphoric acid. Total.	Potash.
4181	Guaranteed Found	—— ——	—— ——	—— ——	12. 12.72
4183	Guaranteed Found	4.11 3.98	6. 8.47	7. 9.45	5. 8.30
4164	Guaranteed Found	2.46 2.57	5. 5.97	6. 7.93	3. 3.94
4177	Guaranteed Found	4.90 5.01	2. 3.51	3. 8.73	—— ——
4182	Guaranteed Found	3.30 3.47	8. 8.94	9. 9.48	10. 10.56
4173	Guaranteed Found	7.50 8.03	4. 4.98	5. 6.14	—— ——
4184	Guaranteed Found	3.30 3.42	8. 9.42	9. 9.76	7. 7.46
4185	Guaranteed Found	2.46 3.05	—— ——	22. 26.25	—— ——
4486	Guaranteed Found	—— 1.28	—— ——	—— .30	—— 3.62

ANALYSES OF SAMPLES OF AGRICULTURAL LIME.

NAME AND ADDRESS OF MANUFACTURER OR JOBBER.	Brand or trade name.	Locality where sample was taken.	Number.		Calcium oxide. Per ct.
American Lime & Stone Co., Tyrone, Pa.	Hydra Oxide of Lime	Horseheads	4496	G* F	66.75 65.50
Baker Co., J. E., York, Pa.	Victor Ground Limestone	Warsaw......	4459	G* F	47. 47.75
Baker Co., J. E., York, Pa.	Victor Ground Limestone	Cameron.....	4751	G* F	47. 48.60
Baugh & Sons Co., Baltimore, Md.	Baugh's Genuine Nova Scotia Land Plaster	Waverly......	4422	G* F	—— 37.14
Caledonia Chemical Co., The, Caledonia, N. Y.	Better Farming Lime	Caledonia	4517	G* F	50. 48.92
Conley Stone Co., F. E., Utica, N. Y.	Raw Ground Lime	Hilton	3966	G* F	51.5 53.90
Consolidated Wheatland Plaster Co., Wheatland, N. Y.	Land Plaster	Avoca	4724	G* F	34. 29.96
Edison Portland Cement Co., The, Stewartsville, N. J.	Pulverized Lime Stone	Syracuse.....	4138	G* F	50. 52.24
Farnam Cheshire Lime Co., Farnams, Mass.	Farnam Cheshire Lime Co.'s Agricultural Lime	Harpersville	4400	G* F	60. 57.37
Genesee Lime Co., Honeoye Falls, N. Y.	Genesee Hydrate	Irondequoit	4455	G* F	65. 69.20
International Agricultural Corp., Caledonia Marl Branch, Caledonia, N. Y.	Lime Carbonate	Canandaigua	3989	G* F	50. 49.84
International Agricultural Corp., Caledonia Marl Branch, Caledonia, N. Y.	Lime Carbonate	Rochester	3998	G* F	50. 47.62
Kelley Island Lime & Transport Co., The, Cleveland, O.	Tiger Brand Ground Quick Lime	Little Valley	5001	G* F	76. 69.11

* G and F mean, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF AGRICULTURAL LIME.

Name and Address of Manufacturer or Jobber.	Brand or trade name.	Locality where sample was taken.	Number.		Calcium oxide. Per ct.
Le Roy Lime Works & Stone Quarries, Le Roy, N. Y.	Le Roy Agricultural Lime	Le Roy	4501	G* F	——— 67.91
New York Lime Co., Natural Bridge, N. Y.	White Crystal Brand Hydrated Lime	Boonville	3696	G* F	——— 67.20
Ohio & Western Lime Co., The, Huntington, Ind.	Ground Quick Agricultural Lime	Falconer	3282	G* F	54.46 46.39
Pridoi & Co., S. W., Norfolk, Va.	White Beach Pure Nova Scotia Land Plaster	Glens Falls	4089	G* F	——— 40.30
Rock Cut Stone Co., Syracuse, N. Y.	Ground Limestone	Irondequoit	4456	G* F	——— 35.58
Rockland & Rockport Lime Co., Rockland, Me.	R R Land Lime	Amsterdam	3686	G* F	55. 63.78
Security Cement & Lime Co., Berkeley, W. Va.	Berkeley Ground Lime	Allegany	4266	G* F	90. 84.49
Security Cement & Lime Co., Berkeley, W. Va.	Berkeley Hydrated Lime	Buffalo	3394	G* F	70. 72.
Security Cement & Lime Co., Berkeley, W. Va.	Ground Limestone	Buffalo	3395	G* F	44. 50.41
Solvay Process Co., The, Syracuse, N. Y.	Land Lime	Boonville	3698	G* F	60. 70.06
Solvay Process Co., The, Syracuse, N. Y.	Solvay Land Lime	Baldwinsville	4146	G* F	60. 67.90
Standard Lime & Stone Co., The, Martinsburg, W. Va.	Standard Ground Limestone	Collins	3352	G* F	53. 54.18
Standard Lime & Stone Co., The, Martinsburg, W. Va.	Standard Hydrated Lime	Silver Springs	4460	G* F	60. 72.36
Stonemeal Fertilizer Co., Inc., Paterson, N. J.	———	Pine Island	3623	G* F	——— 18.02
Warner Company, Chas., Philadelphia, Pa.	Cedar Hollow Limoid	Union	4670	G* F	47. 46.54

* G and F mean, respectively, Guaranteed and Found.

ANALYSES OF SAMPLES OF AGRICULTURAL LIME.

Name and Address of Manufacturer or Jobber.	Brand or trade name.	Locality where sample was taken.	Number.		Calcium oxide. Per ct.
Warner Company, Chas., Philadelphia, Pa.	Cedar Hollow Limoid	Avoca	4725	G* F	47. 46.52
Whittleton, John A., Medina, N. Y.	Agricultural Lime	Williamson	3738	G* F	—— 31.01
Whittleton, John A., Medina, N. Y.	Land Lime	Clarence	4330	G* F	—— 31.28

ANALYSES OF SAMPLES OF LIME COMPOUNDS.

Name and Address of Manufacturer or Jobber.	Brand or trade name.	Locality where sample was taken.	Number.	Phosphoric acid.		Potash.	Calcium oxide.
				Available.	Total.		
Caledonia Marl Branch, Caledonia, N. Y.	Wood Ashes Substitute	Caledonia	4503	1.50 1.22	2.50 1.85	5. 6.40	35. 37.62
Caledonia Chemical Co., The, Caledonia, N. Y.	Wood Ashes Substitute	Caledonia	4516	1.50 1.28	2.50 1.92	5.50 5.52	35. 40.52
Caledonia Chemical Co., The, Caledonia, N. Y.	Wood Ashes Substitute	Guilderland Ctr.	5101	1.30 1.42	—— 1.99	5.50 5.96	35. 42.30
Stevens, Charles, Napanee, Ont., Can.	Beaver Brand Canada Unleached Hardwood Ashes	Syracuse	4655	—— ——	1.50 1.41	4. 3.82	30. 25.32

APPENDIX.

I. Popular Editions of Station Bulletins.

II. Periodicals Received by the Station.

III. Meteorological Records.

POPULAR BULLETIN REPRINTS.

PRUNING FAILS TO CONTROL A CURRANT DISEASE.*

F. H. HALL.

An old, obscure disease.

More than twenty years ago, a disease was discovered which has become today a very destructive trouble in the currant plantations of the Hudson Valley. The cause of this disease remained long unknown; but careful study by botanists of this Station and the Cornell Station proved it to be due to a fungus which has three distinct spore forms. Of these, the basal form is *Botryosphœria ribis,* so that this stands as the scientific name of the fungus which causes currant blight, currant cane blight, or currant cane necrosis. Usually, the discovery of the cause of a disease soon leads to a remedy, but in this case no preventive or remedial treatment can yet be recommended.

Symptoms of the disease.

On certain canes, or portions of the canes, the leaves wilt, turn brown and die. An affected cane will show a section of dead wood from one to four inches long where the bark has been killed and wood and pith invaded by the mycelium of the fungus. This hinders the ascent of sap and thereby causes all the upper part of the plant to wither and die. The general appearance is very similar to that caused by borers in the canes, but when this insect is responsible, a distinct burrow will be found and the larva, itself, may be present. In fungus-blighted canes, neither burrow nor larva can be found, but on careful examination, especially with a microscope, fine, whitish, cobwebby threads may be discovered in the discolored pith at the point of attack.

An unsuccessful remedy.

This localization of the injury made it seem possible that summer pruning to remove the diseased wood, with destruction of the affected portions, might check the progress of the disease. Accordingly, two experiments with this apparently promising method of control were begun in the spring of 1907. Within a year or two it was found that the method offered no chance of success in an old plantation. However, the second test, begun in a plantation only one year set, has now been continued for six years, all canes showing signs of the disease being pruned out

* Reprint of Popular Edition of Bulletin No. 357; see p. 143 for Bulletin.

from two to four times each season. This work was done by the Station botanists with great care, but at no time during the progress of the experiment has the disease been noticeably checked. The infections seemed as numerous and as injurious on the treated as on the untreated plats, and the yield of fruit was even smaller on the treated plats. Accordingly, summer pruning can no longer be recommended for the control of necrosis. In fact, no method of treatment can be confidently recommended at present, although experiments in spraying are being continued.

CONTROLLING GRAPE LEAF-HOPPERS IN 1912.*

F. H. HALL.

Weather aids in contest.

Many growers in the Chautauqua grape belt feared very extensive damage from leaf-hoppers in 1912, for millions of those insects went into winter quarters in the fall of 1911. In spite of seemingly unfavorable hibernating conditions — heavy rains, sleet storms and wet snows to beat down the winter refuges of the insects and severe cold to freeze them and keep them frozen in their icy beds for months, no notable diminution of the numbers was observed when they emerged in the spring. But the remarkably cold summer and the long-continued, wet weather in late summer and early fall proved fatal to the nymphs, so that far less damage was done to vineyards as a whole than was feared, though many suffered severely and enough of the tiny pests matured and went into hibernating quarters in the fall of 1912 to threaten serious injury in many vineyards in 1913 unless active measures are taken to combat them.

Destroy hibernating quarters.

No really new method was worked out in 1912, but those recommended in Bulletin 344 proved very effective when thoroughly applied. The experience of this season emphasizes the necessity of destroying the winter refuges of the insects, for whenever there were left undisturbed, to shelter the hoppers, patches of weeds along the fences, a grassy headland in the vineyard, a raspberry or blackberry patch adjoining it, underbrush with collected leaves in adjacent woodlands or similar rubbish in ravines or swales near at hand, the tiny pests would be found swarming in the edges of the vineyards, but gradually decreasing in number until at the center or opposite side there might be few or none of them. Thorough cleaning up of such places, especially by fire after the adult hoppers have gone into winter quarters, is one of the most effective measures to be taken; for this not only destroys millions of the insects but it also reduces materially the supply of spring food plants and thereby discourages the survivors when they emerge in the spring. No collection of rubbish should be overlooked if it can with any ease or safety be burned, for thousands of the pests may collect in a small accumulation of leaves that have piled up about a broken-

* Reprint of Popular Edition of Bulletin No. 359; see p. 287 for Bulletin.

over tuft of tall grass. The ordinary cover crops in the vineyard, which remain green until late in the fall, do not appear attractive to the hoppers as hibernating quarters. The figures given in the two plates show types of grass and weed borders that were found to shelter great numbers of the hoppers. The foot rule in some of the figures shows how small these patches are, yet they were marked centers of infestation.

Early feeding. Especial attention should be given wild blackberry and raspberry patches; for these are favorite food plants of the insects, and carry them over from their first appearance until the grape foliage has made some little growth. Other food plants that should be destroyed when practicable are wild strawberry, burdock, catnip and Virginia creeper. The hoppers feed on these wild plants until the middle of May or later, not passing to the vineyards until the grape leaves are of considerable size. (See Plate IV, fig. 1.) By June 1st, practically all of the insects have made their way to the grape vines.

Fortunately for the vineyardist the hoppers seem to prefer as food, after they have attacked the grapes, the leaves low down on the vines, particularly those on the suckers that are later removed. Here, of course, their feeding does comparatively little harm. These suckers should be removed, however, before spraying begins.

Control by spraying. Against the later attacks by the nymphs spraying with nicotine is found very effective if thoroughly done; and the automatic "hopper" sprayer described in Bulletin 344 makes it possible to do effective work economically. This attachment, on sprayers of many makes, has proven thoroughly practicable; though some care in driving is necessary to prevent bending or even breaking the booms. In seven vineyards in which experimental spraying was done, the hoppers were so well controlled that the uniform green of the sprayed vines contrasted strongly with the yellowish, sickly tinge of the vines not sprayed, either those left as checks in the experimental vineyards or those in adjoining untreated plantings. One spraying with Black Leaf 40, one part to 1,600 parts of water, was sufficient to give good control of the insects, even in two cases when the nymphs had reached the fifth instar, or last stage before becoming adults.

Chance for wrong diagnosis. In some of the vineyards the vines appeared yellowish, though the "hoppers" were well controlled, a condition which unfortunately prevailed in the Station experimental vineyard at Fredonia. This unhealthy condi-

tion was due not to the insects but to a disease or physiological trouble, with quite similar symptoms. The differences between the yellowing due to hoppers and that due to this "leaf blight (?)" should be learned; since it is merely a waste of materials to spray with nicotine for the latter trouble. Absence, or presence of only small numbers of the hoppers, coupled with yellowing of the leaves is of course a good indication that the insects are not responsible; and if the leaves show yellow and die at the margins first, with dark areas along the midrib and veins, it is the "leaf blight (?)". rather than "hoppers" that are to blame, for their punctures lead to a quite uniform yellowing of the leaf, at first in the form of minute yellowish dots. The veins also will have a yellowish, punctuated appearance.

Effect of hopper injury. The grape leaf-hopper, as it destroys or makes useless much of the foliage, reduces the crop of fruit for the year of the attack and weakens the vines; but the most striking result of its work is to lower the quality of the fruit. Concord grapes when well ripened are of a rich blue-black color; but when "hoppers" infest the vines, the color changes to a purplish or reddish hue. The sugar also is lessened and the acid increased, so that grapes from badly injured vineyards become unfit for making grape juice and unattractive for market.

In each of the vineyards under experiment samples were taken of grapes from sprayed and from unsprayed vines and the juice pressed out and analyzed. In every set of samples the grapes from the sprayed vines showed more sugar, the increases varying from 8 to 68 per ct. in the different pairs of samples; while the unsprayed grapes had more acid than those from sprayed vines in every case but one, the differences ranging from 0 to 20.6 per ct.

In selecting such comparison samples it is essential that the grapes be taken from corresponding portions of the sprayed and unsprayed vines, since grapes grown on the lower, shaded portions of a vine are lacking in sugar and have an excess of acid as compared with those grown on the upper parts of the vine.

Summary. The work of 1912 on the grape leaf-hopper, then, enforces the practices previously recommended — the destruction of winter refuges of the insects, such as weeds, clumps of dead grass, brush, and particularly clusters of fallen forest leaves; getting rid of spring food plants like raspberry, blackberry, wild strawberry, burdock, etc.; allowing suckers to remain on vines until spraying time; and thorough spraying with a nicotine preparation.

THE BEST APPLES FOR NEW YORK STATE.*

F. H. HALL.

Why grow new varieties? Of the hundreds of apple varieties described in pomological literature not one in ten succeeds in establishing itself as a useful commercial sort or as a general favorite in the home orchard. The great proportion of disappointments when novelties are planted tends to discourage individual testing; for each failure means loss of money, space, time and pleasure. Therefore newcomers are generally distrusted, whether from distant regions where they may have already established good reputations, or from some nearby nursery whose owner believes he has a new seedling or sport that will revolutionize apple-growing. Yet some one must originate and some one test such new apples if orcharding is to progress; for our old varieties are fixed, and probably no one would claim that the perfect apple has yet been grown. Varietal faults as well as merits apparently remain, practically unchanged, as they were on the parent tree.

Strains. In some cases, it is true, "strains" have arisen in varieties, which seem to be, and occasionally are, distinctly different from the parent stock, as the red Collamer and Banks from the light-colored Twenty-Ounce and Gravenstein; and a russet type from the well known Baldwin. These are well-fixed variations, probably bud-sports; but since we know not why they come into being and have no idea how to produce others, their existence does not weaken the conclusion that no changes in old varieties will give us the new kinds we desire. Other so-called "strains," like Olympia, Vandevere Improved and Improved Wagener, when grown on the Station grounds beside Baldwin and

* Reprint of Popular Edition of Bulletin No. 361; see p. 385 for Bulletin.

the old Vandevere and Wagener, are identical with the parents, the "improvement" being an accidental result of surroundings or a figment of the improver's imagination.

"Pedigreed" apples. Much stress has, of late years, been placed on the fact that certain trees of a variety show high productiveness, or bear brighter-colored or longer-keeping fruit; and nurserymen have been urged to propagate from such differing trees, yet there is little or no evidence to show that any apple of today, though grown from the most carefully "pedigreed" stock is permanently any better than its predecessors or its sisters from less favored surroundings. No! To get new qualities or new combinations of qualities in apples we must have new kinds.

Do apple varieties "run out?" But when a variety is established, that is, after the first few years of its life when it may be slightly variable in the matter of size and vigor, we may depend upon its maintaining its characteristics unchanged. There is no scientific or experimental evidence that varieties degenerate any more than that they improve; though the testimony of evidently sincere and careful growers might be produced to sustain either position. It is a common belief that some varieties, at least, show old age or degeneracy; but observations at the Station, made on hundreds of kinds, do not confirm this belief in the least. Trees grow old and produce poor fruit, and varieties disappear because better ones take their place, or are finally condemned because of some undesirable character that is overlooked at first because of many excellencies. In the Station orchards, however, or in other orchards better suited to their requirements, Fall Pippin, Early Harvest, Oldenburg, Red Astrachan, Maiden Blush, Porter, Sweet Bough, Black Gilliflower, Ben Davis, Esopus, Grimes, Hubbardston, Jonathan, Red Canada, Swaar, Tompkins King, Wagener and Winesap so closely resemble in all respects these same fruits as originally described 100 years ago or more, that no one could point out a difference. The Baldwin is more than 150 years old yet still stands the test as the best commercial apple for New York State, and trees of it on the Station grounds from many sources, some of them from buds of trees said to show marked variations, produce fruit uniformly the same under the same conditions. A Rhode Island Greening tree in our orchard, propagated from what is supposed to be the original tree of the variety, about 200 years old, is the same in growth and bears apples no better, no worse, than trees several generations removed from the parent plant. Ribston, Green Newtown, Holland Winter, Pomme Grise, Winter Pearmain and Yellow Bellflower are known to be over 200 years old, yet their trees still grow vigorously and produce well. If apple varieties are wearing out, it is a slow process.

Benefits of apple testing. Since established varieties neither degenerate nor improve and since new varieties are constantly originating it is necessary that some disinterested grower should study these varieties side by side to learn and communicate to intending orchardists those points in which varieties differ one from another and so far as possible to state the truth regarding their utility or lack of it for the orchard planter's needs. This testing the Station does, and in the work has made some studies, comparisons and observations that should be useful. Chief of these is the securing of full descriptive data given in detail for about 700 varieties in the "Apples of New York" and summarized in Bulletin No. 275. Since those publications appeared, 100 or more additional varieties have been grown or listed. It therefore seems best to revise the tabulated descriptions given in Bulletin 275 and to include the new sorts. This table, describing 804 varieties, is given in the regular bulletin bearing the same number as this Popular Edition; while for this edition about 100 varieties have been selected which include practically all apples that have any special value or merit testing in New York State either in the commercial orchard or for home use. This table will be found on pages 736-739.

Apple groups. In handling such numbers of varieties of any fruit, similarities are constantly observed; so that practically all apples fall more or less naturally into "groups,"— collections with very indefinite limits, but including those varieties that have more similarities than contrasts. In many cases these "family resemblances" are so marked that the observer concludes at once that the members of the group trace back more or less directly to a common ancester.

These "groups," though as yet incompletely established and subject to constant change, serve many good purposes; since the behavior of some well-known member of a group, frequently the "name parent," may give a clue to the behavior of the whole collection and enable us to decide at once that an unknown member of the group is worth consideration or should be rejected. For instance, we would not look in the Early Harvest group for a winter apple, in the Lady group for one to supply a commercial pie factory, nor in the Wealthy group for a variety for Long Island.

The characteristics of some of these "groups" that are of value in New York, with well-known representatives of each, are noted in succeeding paragraphs. It should be said that not all the varieties named in the groups are valuable, for sometimes a very characteristic member of a group is, by some special quality, rendered useless under particular conditions. For the valuable varieties, the table is the guide.

Aport group.— Large, handsome, fall apples, coarse in texture and of medium quality. Some members of the group are adapted to all parts of New York.

Alexander, Bietigheimer, Bismarck, Constantine, Wolf River.

Baldwin group.— Highly colored, long keeping, well flavored, rather large apples with similarities in texture, flavor, form and color markings. Adapted to all districts but most northern in State.

Arctic, Baldwin, Sutton.

Ben Davis group.— Rather large, bright red apples, coarse and solid in texture, with indifferent flavor and thick skin, shipping well and keeping well.

Ben Davis, Black Ben Davis, Gano, Saratoga, Schenectady.

Black Gilliflower group.— Medium sized, dark red, oblong, ribbed apples of good quality but rather dry and coarse in texture. Less hardy than the Baldwin group. Particular as to soils.

Black Gilliflower, Deacon Jones, Striped Gilliflower.

Blue Pearmain group.— Somewhat large, dull red with bluish bloom, mild flavor, fair quality, dense texture and thick skins. For most part valuable only under northern conditions.

Bethel, Blue Pearmain, Jewett Red.

Chenango group.— Medium sized, red striped, oblong conic apples of high quality, peculiar aroma and delicate texture. Succeed where the Baldwin can be grown.

Chenango, Stump.

Early Harvest group.— Summer apples of medium size, pale yellow or white in color, of good but not superior quality and with delicate breaking flesh. Adapted to warmer parts of State.

Early Harvest, Early Ripe, Parry White.

Fameuse group.— Medium sized, handsome red usually striped apples, roundish oblate, thin skinned, of high dessert quality, and pure white tender flesh. A tendency to reproduce true from seed is a striking peculiarity. As a group, predisposed to fungus troubles. The most valuable group for the colder portion of the State.

Cortland, Fameuse, McIntosh, Onondaga, Otsego, Shiawassee.

Jonathan group.— Medium sized, handsome red apples of high quality, and crisp, juicy flesh. Variable in adaptations. Resembles the Baldwin group.

Esopus, Jonathan, King David, Red Canada, Rensselaer, Rockland.

Lady group.— Very small, roundish oblate, dessert apples, handsome in color and sprightly in quality, with crisp, juicy flesh, thin skin, and good keeping qualities. Best adapted to the Hudson Valley and Long Island districts.

Highland, Lady, Sleight.

Northern Spy group.— Large, striped red, roundish oblate, ribbed, delicate bloom, juicy, crisp, fine grain, of highest flavor and quality. Fastidious as to soils but probably can be grown in congenial locations in all but the coldest portions of the State.

Melon, Northern Spy, Ontario, Oswego, Schoharie. Wagener.

Oldenburg group.— Medium to above in size, variously striped with red, generally ripening in fall and of comparatively short season. Tart, culinary apples with but few dessert sorts. Russian. Probably the most cosmopolitan of the groups here listed — some members succeeding in all parts of New York.

Anis Rose, Autumn Streaked, Oldenburg. Gravenstein Section: Banks, Gravenstein.

Reinette group.— With few exceptions rather large in size, of green or yellow ground color, with or without blush, and generally of good quality. A large and poorly defined group which is here divided into four sections. Nearly all of the members, with the exception of a few in the Newtown section, thrive in New York; but not many of them in the northern district.

Fall Pippin Section: Boiken, Fall Pippin, Hawley, Lowell, Maiden Blush, Winter Banana. Rhode Island Greening Section: Autumn Swaar, Northwestern Greening, R. I. Greening. Newtown Section: Clinton, Green Newtown, Grimes, Peck Pleasant, Winchester, Yellow Newtown. Swaar Section: Mann, Seneca Favorite, Swaar.

Romanite group.— Variable in size, highly colored, from poor to good in quality, keeping very late. Mainly southern apples.

Pennock, Stark, York Imperial.

Russet group.— Ranging from small to above medium in size, russet colored, with peculiarly fine-grained, dense texture, sprightly flavor and good-keeping quality. Some member succeeds in each of the New York districts.

Golden Russet, Roxbury.

Tompkins King group.— Early winter apples, large, attractively striped with red, variable but symmetrical in form, of superior quality and characteristic dense, coarse texture and aromatic, yellowish flesh. Especially suited to the western New York districts.

Hubbardston, Ribston, Tompkins King.

Twenty Ounce group.— Large, late fall, broadly splashed red apples, roundish in form, of good quality and with a coarse, yellowish, aromatic flesh. Grown more or less generally in all but the most northern districts.

Collamer, Twenty Ounce.

Wealthy group.— Fruit undersized on old trees. Early and abundant croppers. Hardy and adapted to all of the apple districts of New York.

Peter, Wealthy and several Minnesota seedlings.

Winesap group.— Winter apples, medium to large in size, dark red, rather solid and of fine grain, of good but not high quality, good keepers. Apples of the South and West.

Arkansas, Oliver, Winesap.

Yellow Bellflower group.— Medium to large apples, characteristically oblong conic, predominantly yellow, with a large somewhat remarkably open core. Flesh firm, crisp, aromatic and of high quality for culinary purposes.

Barry, Mason Orange, Yellow Bellflower.

Of the following groups no variety is of special importance in New York: Lawver, Limbertwig, Longfield, Lowland Raspberry, Newtown Spitzenburg, Ralls, Ramba, Red Astrachan, Rome, Sweet Bough, Vandevere and Yellow Transparent.

Seedless apples.

Seedless apples are not new though the stir made about one variety a few years ago might have led those uninformed into thinking them one of nature's newest and most marvelous developments. Yet both Greek and Roman writers describe them and references to them have not been uncommon down through the pomological ages. However, we know nothing of how they arise, so are working in the dark in any attempt to secure new varieties of apples without seeds; and each of the old varieties has too many bad qualities to make propagation merely for seedlessness advisable. But a seedless and coreless apple as good as Baldwin or dozens of other sorts would almost revolutionize apple growing; so it is worth while to do breeding work with these peculiar fruits, though the very factor that makes them valuable adds double difficulty for the breeder. Some seeds are borne on every "seedless" apple tree, however; and no one seems to know whether these seeds will or will not tend to produce trees bearing similar fruit. References have been found to nearly 40 seedless apples reported in the United States within the past twenty years; and the Station has upon its grounds trees of nine such varieties. We have already begun crossing and other breeding work with them, and will be glad to have cions or buds of other seedless sorts with the hope that from some existing variety may be bred a worthy variety without seeds.

Apples for New York districts. In the table which follows an attempt has been mad to indicate, to some extent, the local adaptations of var eties; for which purpose the State has been divided int nine fruit districts, whose borders correspond, roughly, t those shown on the title page map. The purpose of othe columns of the table will be understood by a study of the headings and th

APPLE VARIETIES FO

ABBREVIATIONS.— *Size.*— l, large; m, medium; s, small; v, very. *Form.*— a, angular; c, conica l, light; r, red; ru, russet; s, striped; w, white; y, yellow. *Flavor.*— a, acid; b, brisk; m, mild; s, swee *Starring.*— *, recommended; **, well recommended; +, worthy of trial.

No.	VARIETY.	Origin.	Bearing age.	Form.	Size.	Color of skin.	Color of flesh.	Flavor.	Quality.	Use.	Season.
1	Akin	Ill.	8 yrs.	r o i	m	y r s	y	b sa	g	d	Jan., Jun
2	Alexander	Rus.	......	r o c	vl	y r s	y w	m sa	f—g	k	Sept., No
3	Anis Rose	Rus.	......	r o	m—l	y w r s	w	sa	g	k	Aug., Sep
4	Arctic	N. Y.	......	r o c	l—m	y r s	y	m sa	g	k	Oct., Feb
5	Autumn Bough	Am.	......	ob c	l	y	w	s	vg	d k	Aug., Sep
6	Baldwin	Mass.	8 yrs.	r c	l	y r s	y	b sa	g—vg	d k	Nov., Ma
7	Banks	A bud sport of Gravenstein, much higher colored than that variety.									
8	Baxter	Can.	......	r c	l—vl	y r s	y	m sa	f—g	k	Nov., Jan
9	Ben Davis	Ky.	4 yrs.	r ob c	m—l	y r s	w y	m sa	g	k	Jan., Jun
10	Bethel	Vt.	......	r c	l	y r s	w	m sa	f—g	k d	Nov., Ma
11	Bismarck	N. Z.	7 yrs.	r o c	l—vl	y r s	w	sa	f—g	k	Oct., Dec.
12	Black Ben Davis	Ark.	5 yrs.	r c	m—l	y d r	w	m sa	g	k	Jan., Ap
13	Black Gilliflower	Am.	12 yrs.	ob c	m—l	y g d r	w	m sa	g	d k	Oct., Feb
14	Boiken	Eu.	5 yrs.	o c a	m—vl	y b	w	b sa	g	k	Nov., Ma
15	Chenango	N. Y.	......	r ob c	l—m	y r s	w	m sa	g—vg	d	Aug., Sep
16	Collamer	A red strain of Twenty Ounce.									
17	Constantine	Rus.	......	r c	l—vl	g y r s	g w	b sa	f—g	k	Sept., Nov
18	Cornell	Pa.?	......	r o c	l—m	y r s c	w	sa	vg	d	Sept., Nov
19	Cox Orange	Eng.	......	r o	m	y r s	y	m sa	vg—b	d	Sept., Jan
20	Deacon Jones	Pa.	8 yrs.	.r c	l—vl	y r	y w	m sa	f—g	k	Nov., Ma
21	Delicious	Iowa	9 yrs.	r ob c	l	y r s	y	sa	g	d k	Dec., Ma
22	Early Harvest	Am.	4 yrs.	r o	m	y	v w	sa	g—vg	d	July, Aug
23	Early Joe	N. Y.	......	o c	s—m	g y r s	w	m sa	vg—b	d	Aug., Sept
24	Esopus *Spitzenburg*	N. Y.	9 yrs.	r c	m—l	y r s	y	sa	vg—b	d k	Nov., Feb
25	Fall Pippin	Am.	9 yrs.	r o	l—vl	g y	w	sa	vg	d k	Sept., Jan
26	Fameuse	Unk.	5 yrs.	r o	m	y r s	w	sa	vg	d	Oct., Dec.
27	Fanny	Pa.	......	r o c	m	y r s	w y	m sa	g—vg	d	Sept., Nov
28	Fishkill	N. Y.	......	r o	l—vl	y r	w y	m sa	f—g	k	Nov., Feb
29	Gano	Unk.	......	r c	m	y r s	y w	m sa	g	k	Dec., Apr.
30	Golden Russet	Eng.?	9 yrs.	r o c	m	g y ru	g y	sa	vg	d k	Dec., Apr.
31	Gravenstein	Eu.	8 yrs.	o	l	y r s	y	sa	vg—b	d k	Sept., Nov
32	G'n and Y'l'w Newtown.	N. Y.	5 yrs.	r o	m—vl	g y	g w	sa	b	d k	Feb., May
33	Grimes	W. Va.	......	r ob	m—l	y	y	sa	vg—b	d k	Nov., Feb
34	Hawley	N. Y.	......	r	l—vl	g y	y	m sa	vg	d	Sept., Nov
35	Hook	N. Y.?	......	r ob c	m	g y	w y	m sa	vg	d	Oct., Nov.
36	Hubbardston	Mass.	9 yrs.	r c	l	y r s	y	m sa	vg—b	d k	Oct., Jan.
37	Jefferis	Pa.	4 yrs.	r o	s—m	g y r s	w y	m sa	vg	d	Sept., Jan
38	Jersey Sweet	Unk.	......	r c	m	y r s	w y	s	g—vg	d	Sept., Dec.
39	Jew tt Red	N. H.	......	r o	m	y r s	....	m sa	g—vg	d	Oct., Feb.
40	Jonathan	N. Y.	......	r c	m	y r s	y	sa	vg—b	d k	Nov., Jan.
41	King David	Ark.	......	r o c	l	y d r	y	b sa	g	k	Nov., Jan.
42	Lady	Fr.	12 yrs.	o	s—vs	y b	w	sa	g—vg	d	Dec., May
43	Lady Sweet	N. Y.	9 yrs.	r c	l—m	y g r s	w y	s	vg—b	d k	Nov., Apr.
44	Longevity	Can.	......	r c	l	g y r	y	sa	g	k	Jan., Mar.
45	Lord Seedling	N. Y.	......	r ob c	m	y	y w	m sa	g—vg	d k	Sept., Oct.

key to abbreviations that is given at the top of the pages. It should be said that the months under "Season" mark the beginning of edibility of the variety and the end of its season in ordinary storage. Those varieties are included that have been grown and selected at the Station as a result of its apple-breeding work. These are recommended for testing.

NEW YORK STATE.

i. irregular; o, oblate; ob, oblong; ov, ovate; r, roundish. *Color.*— b, blush; c, carmine; d, dark; g, green; sa, subacid. *Quality.*— b, best; g, good; f, fair; p, poor; v, very. *Use.*— d, dessert; k, kitchen.

No.	Long Island.	Hudson Valley.	St. Lawrence and Champlain Vl'ys.	Mohawk Valley.	Eastern Plateau.	Central Lakes.	Ontario Shore.	Erie Shore.	Western Plateau.	REMARKS.
1	+	+	....	...	...	+	...	...	...	A beautiful apple of good quality.
2	*	*	**	**	...	**	**	**	*	Trees good. Fruit large, beautiful, of fair quality.
3	+	+	+	+	+	+	+	+	+	Worthy of testing.
4	...	...	*	*	...	...	...	...	...	Worthy of trial in northern New York.
5	*	*	....	*	*	*	*	*	*	Ranks among our best sweet apples.
6	**	**	**	**	**	**	**	**	**	Standard winter apple of New York.
7	+	+	+	+	+	+	+	+	+	
8	...	...	**	*	...	...	...	...	...	Valuable in northern New York.
9	**	**	....	...	...	**	**	**	...	Hardy, healthy, vigorous, productive. Lacks quality.
10	...	...	**	...	...	...	...	...	...	Blue Pearmain type. Valuable in northeastern New York.
11	*	*	**	*	*	*	*	*	*	Tree hardy, healthy; bears young and productive. Fruit attractive but inferior in quality.
12	**	**	....	...	...	**	**	**	...	Ben Davis type, and of value.
13	**	**	....	...	...	**	**	**	...	An old but still valuable variety.
14	...	*	*	*	*	*	...	*	*	Widely planted as a filler, but not very desirable.
15	**	**	....	**	**	**	**	**	**	Attractive, good quality, easily bruised; excellent.
16	**	**	*	*	**	**	**	**	**	
17	*	*	**	**	*	*	*	*	*	Tree and fruit characters good. Subject to blight. A market sort desirable as a filler.
18	+	+	+	+	+	+	+	+	+	Recommended by U. S. Department of Agriculture.
19	*	*	....	...	...	+	+	+	...	Desirable for the home orchard.
20	+	+	+	+	+	+	+	+	+	An attractive market fruit. Heavy bearer.
21	+	+	+	+	+	+	+	+	+	Well worth testing in New York.
22	*	*	....	...	...	*	*	*	*	Valuable only as an early dessert apple.
23	*	*	....	...	...	*	*	*	*	Of value for the home orchard only. High quality.
24	**	**	....	**	**	**	**	*	*	Lacks vigor. Unproductive. Best quality.
25	**	**	*	*	**	**	**	**	**	A standard variety. Recommended.
26	...	...	**	*	*	...	...	...	*	Hardy, productive. Fruit scabs badly, tender, small.
27	*	*	....	...	*	*	*	*	*	Vigorous, productive. Fruit bright red, good, small.
28	...	...	*	*	*	...	...	...	...	Worth planting in certain localities.
29	**	**	....	...	...	**	**	**	...	Valuable where Ben Davis thrives.
30	*	*	....	*	*	*	*	*	*	Hardy, vigorous, productive. Small, late, excellent.
31	*	**	**	*	*	*	*	*	*	Bears early, productive, vigorous. Attractive, excellent.
32	**	**	....	...	**	*	*	...	...	Standard in quality. Succeeds in certain localities only.
33	*	*	....	...	*	*	*	*	*	Beautiful and of high quality. Not always reliable.
34	*	*	....	...	*	*	*	*	*	Handsome and delicious, but poor tree characters.
35	...	*	*	*	*	...	...	...	...	Unattractive, but excellent.
36	**	**	....	*	*	**	**	*	*	Bears early, productive. Fruit handsome and good.
37	*	*	....	...	*	*	*	*	*	Excellent for the home orchard.
38	*	*	....	...	*	*	*	*	*	One of the best sweet apples for home use.
39	...	...	*	*	...	...	...	...	...	One of the best in quality of the Blue Pearmain type.
40	**	**	....	*	**	*	*	*	*	Excellent but small in New York.
41	+	+	+	+	+	+	+	+	+	Appears promising as a commercial sort.
42	*	*	....	*	*	*	*	*	*	A beautiful fancy apple suitable for special trade.
43	*	**	....	*	*	*	*	*	*	One of the most desirable of the sweet apples.
44	+	+	+	+	+	+	+	+	+	Not fully tested. Attractive and appears promising.
45	+	+	+	+	+	+	+	+	+	New and recommended for home orchards.

APPLE VARIETIES FOR

ABBREVIATIONS.— *Size.*— l, large; m, medium; s, small; v, very. *Form.*— a, angular; c, conical; l, light; r, red; ru, russet; s, striped; w, white; y, yellow. *Flavor.*— a, acid; b, brisk; m, mild; s, sweet; *Starring.*— *, recommended; **, well recommended; +, worthy of trial.

No.	VARIETY.	Origin.	Bearing age.	Form.	Size.	Color of skin.	Color of flesh.	Flavor.	Quality.	Use.	Season.
46	Lowell	Am.	......	r ob c	l	y	y	sa	g—vg	d k	Aug., Oct.
47	Lowland Raspberry	Rus.	......	r c	m—l	w r s	w	m sa	vg	d	Aug.
48	McIntosh	Can.	6 yrs.	r	m—l	y r s	w	m sa	vg—b	d	Oct., Dec.
49	Maiden Blush	N. J.	4 yrs.	o	m	y b	w	sa	g	k	Sept., Nov
50	Melon	N. Y.	4 yrs.	r o c	l—m	y g r s	w	sa	vg	d	Oct., Jan.
51	Mother	Mass.	9 yrs.	r c	m	y r s	y	m sa	vg—b	d	Sept., Jan
52	Northern Spy	N. Y.	13 yrs.	r c	l—vl	y r s	y w	sa	vg—b	d k	Dec., Feb.
53	Oldenburg	Rus.	2 yrs.	r o	m—l	g y r s	y w	sa	g—vg	k	Aug., Sept
54	Opalescent	O.?	......	r c	l—vl	y d r	y w	m sa	g—vg	d	Oct., Jan.
55	Porter	Mass.	......	ob c	s—l	y b	y	sa	g—vg	d k	Sept., Nov
56	Primate	N. Y.	3 yrs.	r o c	m—l	y g b	w	sa	vg—b	d	Aug., Sept
57	Pumpkin Sweet	Conn.	9 yrs.	r c	l—vl	g y	w	s	g	k	Oct., Jan.
58	Red Astrachan	Rus.	5 yrs.	r c	m—l	y r s	w	b sa	g—vg	d k	Aug., Sept
59	**Red Canada**	**N. Eng.?**	......	**r c**	**m**	**y r s**	**w**	**m sa**	**g—b**	**d k**	**Nov., Mar**
60	**Rhode Island *Greening***	**R. I.**	**5 yrs.**	**r o**	**l**	**y g**	**y**	**sa**	**vg**	**d k**	**Oct., Mar.**
61	**Rome**	**O.**	**2 yrs.**	**r o c**	**l**	**g y r s**	**y**	**sa**	**g**	**k**	**Nov., Mar**
62	**Roxbury**	**Mass.**	......	**r o**	**l—m**	**y ru**	**y w**	**sa**	**g—vg**	**d k**	**Dec., May**
63	**Sekula**	**Unk.**	......	**o**	**l**	**g y d r**	**g w**	**m sa**	**f**	**k**	**Dec., Mar**
64	**Stark**	**O.**	......	**r c**	**l—m**	**y r s**	**y**	**m sa**	**f—g**	**k**	**Jan., June**
65	**Stump**	**N. Y.**	**7 yrs.**	**r ob c**	**m—s**	**w y r s**	**w y**	**sa**	**vg**	**d**	**Sept., Oct**
66	**Sutton**	**Mass.**	**9 yrs.**	**r**	**m**	**y r s**	**w**	**m sa**	**g—vg**	**d k**	**Nov., Mar.**
67	**Swaar**	**N. Y.**	......	**r o**	**l—m**	**g y**	**y**	**m sa**	**vg—b**	**d**	**Nov., Apr.**
68	**Sweet Bough**	**Am.**	......	**r ob c**	**l—m**	**g y**	**w**	**s**	**g—vg**	**d k**	**Aug., Sept**
69	**Sweet Winesap**	**Pa.**	......	**r c**	**m—l**	**w y r s**	**w y**	**s**	**g—vg**	**d k**	**Nov., Apr**
70	**Tolman *Sweet***	**Mass.**	**8 yrs.**	**r**	**m**	**y**	**w**	**s**	**g—vg**	**d k**	**Nov., Jan.**
71	**Tompkins King**	**N. J.?**	**5 yrs.**	**r c o**	**l—vl**	**y r s**	**y**	**sa**	**vg—b**	**d k**	**Oct., Jan.**
72	**Twenty Ounce**	**Conn.**	**5 yrs.**	**r c**	**vl**	**g y r s**	**w y**	**sa**	**g**	**k**	**Sept., Dec**
73	**Wagener**	**N. Y.**	**4 yrs.**	**r o**	**m—l**	**y r s**	**y**	**sa**	**vg—b**	**d k**	**Oct., Feb.**
74	**Wealthy**	**Minn.**	**6 yrs.**	**r o c**	**l—m**	**y r s**	**y w**	**sa**	**g—vg**	**d k**	**Oct., Jan.**
75	**Winter Banana**	**Ind.**	**5 yrs.**	**r o c**	**l**	**w y b**	**y**	**m sa**	**g—vg**	**d k**	**Nov., Jan**
76	**Yellow Bellflower**	**N. J.**	**9 yrs.**	**r ob c**	**m—vl**	**w y b**	**y**	**b sa**	**g**	**k**	**Dec., Apr.**
77	**Yellow Transparent**	**Rus.**	**4 yrs.**	**r o c**	**m**	**w y**	**w**	**sa**	**g—vg**	**d k**	**July, Aug.**
	STATION SEEDLINGS.										
78	**Clinton**	**N. Y.**	**4 yrs.**	**r o c**	**l**	**g y b**	**y**	**sa**	**g**	**k**	**Dec., Feb.**
79	**Cortland**	**N. Y.**	**6 yrs.**	**r o**	**l**	**y d r s c**	**w**	**sa**	**g**	**d k**	**Nov., Feb**
80	**Herkimer**	**N. Y.**	......	**r ob c**	**m—l**	**g y r s c**	**y**	**b sa**	**g**	**k**	**Dec., Mar**
81	**Montgomery**	**N. Y.**	......	**r o c**	**l**	**g w r s**	**w**	**b sa**	**g**	**k**	**Sept., Oct.**
82	**Nassau**	**N. Y.**	......	**o**	**m**	**y r s**	**y w**	**sa**	**g**	**k**	**Dec., Mar**
83	**Onondaga**	**N. Y.**	**6 yrs.**	**r c**	**l**	**g y d r s**	**w y**	**sa**	**g**	**k**	**Nov., Jan.**
84	**Oswego**	**N. Y.**	**6 yrs.**	**r c**	**l**	**g y d r s**	**y**	**b sa**	**vg**	**d**	**Dec., Apr**
85	**Otsego**	**N. Y.**	**4 yrs.**	**r ob c**	**m**	**y d r s c**	**y**	**m sa**	**g**	**d**	**Nov., Feb**
86	**Rensselaer**	**N. Y.**	**5 yrs.**	**r c**	**l**	**y b r**	**y**	**sa**	**g**	**d**	**Dec., Feb.**
87	**Rockland**	**N. Y.**	......	**r o**	**m—l**	**y d r s c**	**y**	**sa**	**g**	**d k**	**Nov., Jan**
88	**Saratoga**	**N. Y.**	**5 yrs.**	**r o c**	**l**	**g y r**	**w y**	**sa**	**g**	**k**	**Jan., Apr.**
89	**Schenectady**	**N. Y.**	**5 yrs.**	**r c**	**l**	**g y r c**	**y w**	**sa**	**g**	**k**	**Nov., Jan.**
90	**Schoharie**	**N. Y.**	**6 yrs.**	**r ob c**	**l**	**y d r s**	**y**	**m sa**	**g**	**d k**	**Nov., Mar.**
91	**Tioga**	**N. Y.**	......	**r o c**	**l**	**w y b**	**y**	**b sa**	**g**	**k**	**Dec., Mar.**
92	**Westchester**	**N. Y.**	**4 yrs.**	**r c**	**l**	**y b r**	**y**	**m sa**	**g—vg**	**d k**	**Nov., Jan.**
	CRABAPPLES.										
93	**Excelsior**	**Minn.**	......	**r o**	**l**	**y r**	**w**	**sa**	**g—vg**	**d k**	**Sept.**
94	**Gibb**	**Wis.**	......	**r o**	**l**	**y b r**	**y**	**sa**	**g**	**k**	**Aug.**
95	**Hyslop**	**Unk.**	......	**r c**	**l—m**	**y d r**	**y**	**sa**	**g**	**k**	**Sept., Oct.**
96	**Martha**	**Minn.**	......	**o**	**m—l**	**y r**	**y**	**b sa**	**g—vg**	**d k**	**Sept., Nov.**
97	**Transcendent**	**Am.**	......	**r ob c**	**m—l**	**y b**	**y**	**sa**	**vg**	**k**	**Aug., Sept.**
98	**Whitney**	**Ill.**	......	**r c**	**l**	**y r s**	**y**	**m sa**	**g—vg**	**d k**	**Aug., Sept.**

NEW YORK STATE.— (*Concluded*).

i, irregular; o, oblate; ob, oblong; ov, ovate; r, roundish. *Color.*— b, blush; c, carmine; d, dark; g, green; ss, subacid. *Quality.*— b, best; g, good; f, fair; p, poor; v, very. *Use.*— d, dessert; k, kitchen.

No.	Long Island.	Hudson Valley.	St. Lawrence and Champlain Vl'ys.	Mohawk Valley.	Eastern Plateau.	Central Lakes.	Ontario Shore.	Erie Shore.	Western Plateau.	REMARKS.
46	*	*	....	...	*	*	*	*	*	Desirable for home use and local market.
47	+	+	+	+	+	+	+	+	+	A beautiful dessert fruit.
48	*	**	**	**	**	**	**	**	**	One of the best sorts of its season.
49	*	*	....	*	*	*	*	*	*	Worthy of planting for home or market, where it succeeds.
50	*	*	....	*	*	*	*	*	*	Choicely good for the home orchard.
51	*	*	....	...	*	*	*	*	*	Tree characteristics poor. Appearance and quality of the best.
52	*	**	*	**	**	**	**	**	**	Tardy bearer. Vigorous. Highest quality. A standard.
53	**	**	**	**	**	**	**	**	**	Hardy, vigorous, productive, cosmopolitan.
54	+	+	+	+	+	+	+	+	+	Worth planting commercially.
55	*	*	....	*	*	*	*	*	*	Has many merits for home use and local market.
56	*	*	*	*	*	*	*	*	*	Tree characters poor. Valuable for dessert and local market.
57	**	**	....	*	*	**	**	**	*	Valued for home and market purposes.
58	**	**	**	**	**	**	**	**	**	Succeeds under many conditions. Home and local markets.
59	*	*	*	*	*	**	**	*	*	Excellent.
60	**	**	*	**	**	**	**	**	**	The standard green apple of New York.
61	**	**	....	*	*	**	**	**	*	A standard commercial variety.
62	**	**	*	**	**	**	**	**	**	A leading commercial variety.
63	...	+	+	+	+	+	+	+	+	New and worth testing.
64	*	*	....	...	*	*	*	*	*	Considered valuable in some sections of New York.
65	*	*	....	*	*	*	*	*	*	Desirable for home use and for local market.
66	*	**	....	*	*	...	...	...	...	Desirable only in the Hudson Valley.
67	*	*	....	*	*	*	*	*	*	One of the best for the amateur. Requires deep, rich loam.
68	**	**	....	**	**	**	**	**	**	A universal favorite for the home orchard and local market.
69	**	**	....	*	*	*	*	*	*	Attractive, excellent quality; reliable cropper; overbears.
70	**	**	....	**	**	**	**	**	**	Hardy, vigorous, early bearer, reliable cropper.
71	*	*	....	*	**	**	**	*	**	Lacks hardiness, vigor, longevity and productiveness.
72	**	**	*	*	*	**	**	**	*	One of the best fall varieties for home or market.
73	*	*	....	*	*	*	*	*	*	Early bearer; heavy cropper; short lived. Good.
74	**	**	**	**	**	**	**	**	**	Tree and fruit characters good. Small on old trees.
75	*	*	....	*	*	*	*	*	*	Of value for home and local market.
76	*	*	....	*	*	*	*	*	*	Poor cropper. Valuable in some districts. Bruises easily.
77	**	**	**	**	**	*	*	*	*	One of the best extra early sorts for home and market.
78	+	+	+	+	+	+	+	+	+	Type of Green Newtown.
79	+	+	+	+	+	+	+	+	+	Similar to McIntosh. Promising for commercial planting.
80	+	+	+	+	+	+	+	+	+	Apparently of value.
81	+	+	+	+	+	+	+	+	+	Promising but not fully tested.
82	+	+	+	+	+	+	+	+	+	Of superior quality.
83	+	+	+	+	+	+	+	+	+	Resembles McIntosh.
84	+	+	+	+	+	+	+	+	+	Very similar to Northern Spy. Very promising.
85	+	+	+	+	+	+	+	+	+	Probably of value for fancy market.
86	+	+	+	+	+	+	+	+	+	Type of Jonathan with high flavor.
87	+	+	+	+	+	+	+	+	+	Of excellent quality.
88	+	+	+	+	+	+	+	+	+	Type of Ben Davis but quality much superior.
89	+	+	+	+	+	+	+	+	+	Promising as a good market variety.
90	+	+	+	+	+	+	+	+	+	Type of Northern Spy. Promising.
91	+	+	+	+	+	+	+	+	+	Very promising. Resembles Northern Spy except in color.
92	+	+	+	+	+	+	+	+	+	Type of Green Newtown.
93	*	*	*	*	*	*	*	*	*	One of the most desirable of its season.
94	*	*	*	*	*	*	*	*	*	Recommended for home use and possibly for market.
95	**	**	**	**	**	**	**	**	**	Widely and deservedly cultivated for home and market.
96	**	**	**	**	**	**	**	**	**	One of the best.
97	**	**	**	**	**	**	**	**	**	Tree hardy, good grower, very productive. Very popular.
98	*	*	*	*	*	*	*	*	*	One of the most popular of the large crabs.

Disease-resistant varieties

Some diseases of apples, like fire blight, are practically uncontrollable by any means the orchardist yet knows; and others, like scab, while no longer dreaded by the commercial apple-grower, since they can be readily controlled, are destructive in home orchards or village gardens where spraying is not always feasible. On this account varieties that are even partly resistant to such diseases possess at least one character to commend them. Notes have been taken at the Station as regards the behavior of the different varieties in respect to blight and scab; and marked differences have been found in susceptibility. The disease-resistant varieties, are, in many cases, of themselves worthy; so the lists below will be of some use to those about to plant, but they will probably be more useful to breeders; for it is possible — in one case it seems proven — that disease resistance is inherited like any other character. If this be true, breeding for this quality would present no impossibilities, though, like all other breeding work, it may be slow, since with the resistance we must secure the combination of many other desirable characteristics.

SUSCEPTIBILITY OF APPLES TO APPLE SCAB.

Relatively immune.	*Relatively susceptible.*
Ben Davis	Bellflower
Black Gilliflower	Chenango
Gano	Esopus
Gravenstein	Fall Pippin
Grimes	Fameuse
Hubbardston	Green Newtown
Jonathan	Hawley
Oldenburg	Lady
Red Astrachan	Lady Sweet
Rome	Maiden Blush
Roxbury Russet	McIntosh
Sutton	Northern Spy
Swaar	Red Canada
Tolman Sweet	Rhode Island Greening
Tompkins King	Twenty Ounce
Wagener	
Wealthy	
Yellow Transparent	

SUSCEPTIBILITY OF APPLES TO APPLE BLIGHT

Immune in 1906 *(blight very common).*	*Very susceptible.*
Baldwin	Black Gilliflower
Cox Orange	Constantine
Delicious	Esopus
Grimes	Fall Pippin
Lady	Jonathan
Northern Spy	Rhode Island Greening.
Swaar	Rome
Sweet Bough	Sutton
Tompkins King	
Twenty Ounce	
Wagener	

DOES THE FARMER GET PURE SEEDS?*

Much poor seed on market.

During the last six months of 1912 a seed inspection law was in force in New York State, and the examinations of samples, made at the Station under the law and otherwise, plainly show that some such inspection is necessary. Only 125 official samples were examined, but of these one-fifth were below the standard set by the law. This standard is by no means high, either; for the law merely requires that the presence in agricultural seeds of more than three per ct. of foul or foreign seeds must be plainly indicated by a label on the seed package. Of the ordinary weed seeds found in the inspection, three per ct. by count would involve the sowing of 125,000 weed seeds in the 20 pounds of alfalfa seed used on an acre, or three weeds for every square foot of land. If considerable of this impurity chanced to be dodder seed the result would be serious; for the grower of alfalfa should hesitate to sow even one seed to the acre of this pest. This official inspection may be made very helpful, as a check upon seed dealers, but it would not be safe for growers to accept without personal or expert examination seeds even well within the limit of the law, if they wish to avoid weed seeds.

Beside the official samples, the Station also examined, during 1912, more than 1,100 samples of seeds sent in by correspondents and found some marked cases of adulteration. Of 621 samples of alfalfa, 13 contained sand, crushed rock, broken seed, yellow trefoil or similar undesirable material in quantities beyond what would be present naturally. Of the 14 samples of hairy vetch examined, 12 contained seeds of other vetches as an adulterant, notably spring vetch which can not replace the winter vetch as a cover crop. Such adulteration may account for many of the failures of this crop reported. The percentages of dodder-infested samples were also increased over those found in 1911, as 13 per ct. of the alfalfa samples

* Reprint of Popular Edition of Bulletin No. 362; see p. 153 for Bulletin.

and 19 per ct. of those of red clover contained seeds of this harmful weed.

Methods of official inspection. Under the inspection law, samples of seeds were collected from dealers by agents of the Commissioner of Agriculture and sent to the Station for examination. Here the required weight of seed was carefully taken and the seeds therein counted, both crop seeds and weed seeds, so that the percentage "by count," as required by the law, could be ascertained. This process is a very tedious one, the law, in this requirement, differing from most, if not all, other seed inspection laws. Most of these laws specify percentages by weight.

In order to shorten this method, if possible, an attempt was made to establish standards of "count for weight" of the different agricultural seeds; but this was found impossible. The number of seeds in a sample of given weight of any of the farm seeds considered was found to vary, not only in different grades of seeds, but in seeds of the same grade grown in different localities or in different seasons, and even in samples made up of varying proportions of seeds of different color, as of the yellow, brown, or violet-colored seeds of red clover. As illustrations: Two samples of high-grade alfalfa seed contained respectively 213,000 and 250,000 seeds per pound, a difference of 8.2 per ct. above or below the mean for the two samples; and two samples of spring vetch seed varied nearly 25 per ct. from their mean. Since such variations made it impossible to use "count" standards, all seeds in each official sample were counted. By such

Results of official counts. counting, it was found that all of the 11 alfalfa samples were well within the law, the highest percentage of other seeds found being less than one-half of one per ct., and the highest percentage of inert matter (sand, etc.) only one per ct. by weight. With alsike clover, conditions were much worse, since 5 of the 13 samples contained more than 3 per ct. of foreign seeds — one of them 45 per ct.— and two of these samples contained also 5 and 8 per ct. respectively of inert matter. Two of the five samples of Canadian blue grass contained more than the limit of other seeds, and all of them considerable amounts of other material so that the best sample showed only 95 per ct. pure seed and the poorest one only 87 per ct. The Kentucky blue grass was, however, of very much better quality, as the five samples contained very little other seed, though one sample showed 5 per ct., another 3 per ct. and another 2.8 per ct. useless matter. The single sample of crimson clover seed was fair in quality, with 1.2 per ct. of other seeds and 3 per ct. of dirt; but the one sample of rape was 99.1 per ct. pure. Of red clover, 5 samples out of 17 were over 99 per ct. pure, 3 others over 98 per ct. and 4 more over 97 per ct. pure, while the others ranged down to 92.8 per ct., 4 of them containing more than 3 per ct. of other seeds.

Redtop was generally fair in quality, as only one sample out of eight showed more than 3 per ct. of foreign seeds; but all but one ranged high in dirt, one sample showing 36½ per ct. of such refuse.

Nearly 60 samples of timothy were examined, of which only four showed an excess of foreign seeds, but two of these contained respectively 17.1 and 38.9 per ct. of such seeds. The worst of these samples also contained 3.8 per ct. of dirt, but all the other samples were very good in this regard.

The summer vetch sample was very good, but the one of winter vetch was one-fourth summer vetch.

Two of the five samples of white clover were poor, showing 93 and 74 per ct. purity only; but the others were of good quality.

Voluntary examinations. Of 1,140 samples received from correspondents during 1912 and examined at the Station, 621 were of alfalfa, 170 of red clover, 150 of timothy, 96 of alsike clover and 47 of miscellaneous seeds. The same general fault was shown in many of these samples as in those of previous years — small size. The small sample very frequently fails to represent accurately the seed from which it is drawn; and the same statement was found to hold true with regard to the advertising samples sent out by dealers as representative of the seeds they were handling. No sample of alfalfa seed or clover seed weighing *less than two ounces* can be considered satisfactory, nor a sample of grass seed or the smaller vegetable seeds that weighs *less than one ounce*. Quantitative examinations of the voluntary samples could not be made, owing to lack of time; but the principal impurities found in each sample were listed on the report blank, and, if necessary, attention was called to any particularly undesirable weed seeds or to adulterants.

Adulteration. For seeds in general, adulteration is becoming less common, but, as noted before, several samples of alfalfa, red clover and vetch showed that some foreign material had been added to make weight. Alsike clover seed also showed considerable yellow trefoil seed; but one very bad case of this was found due to presence of the trefoil in the clover field, rather than to addition of the seed.

Of practically all the kinds of seed examined, the samples indicated more good to excellent seed on the market than poor to fair seed; but in almost every class some samples showed very bad conditions. Among the kinds in which the number of poor samples was low were alfalfa, timothy, redtop, white clover and Kentucky blue grass; while red clover, alsike clover, and hairy vetch showed considerably larger percentages of low-grade samples. Care should be exercised in the purchase of any of these seeds. The poorest seeds on the market are probably the alsike and timothy mixtures. Of 17 samples of this mixture examined every one was graded poor to very poor, since the seed was poorly colored, shriveled and of light weight, and

very badly contaminated with weed seeds and inert matter. The so-called lawn mixtures are about as bad, though only two samples were examined. The crop seeds were of poor quality, while seeds of 14 bad lawn weeds were found in considerable quantities. Farmers should avoid such mixtures, as it is far more satisfactory to buy the pure seed and mix them as desired.

Impurities found. No specially new or threatening weeds were brought to attention by these examinations, though each year adds many of minor importance to the list of impurities found. Among the dangerous ones commonly found are dodder, mustard, buckhorn, chicory, green foxtail grass, curled dock and trefoil. Russian thistle and roquette seeds were found in many samples, but the experience of the year gives no evidence that they are obtaining any foothold in New York fields, since cultural conditions prevent their spread or continuous growth. Some Johnson grass seeds were found and some inquiries were received regarding it; but it is evidently not yet established in our alfalfa fields.

The following table gives a complete list of the foreign seeds or seed impurities found in samples analyzed, with the number and kind of samples in which they were found.

TABLE I.— FOREIGN SEEDS FOUND IN SEED SAMPLES AND THE NUMBER AND KIND OF SAMPLES IN WHICH THEY OCCURRED.

NAMES OF FOREIGN SEED.	KIND OF CROP SEED.									
	Alfalfa.	Red clover.	Timothy.	Alsike clover.	Alsike and timothy mixture.	Redtop.	Hairy vetch.	White clover.	Kentucky blue grass.	Miscellaneous samples.
Number of samples examined	621	170	150	96	17	14	14	13	14	31
Alfalfa (*Medicago sativa* L.)	...	11	8	16	...	...	...	...	...	1
Alfilaria (*Erodium cicutarium* (L.) L'Her.)	2	1	...	...	...	...	...	...	...	...
Alsike clover (*Trifolium hybridum* L.)	60	99	111	...	...	...	...	11	2	7
Ax seed (*Coronilla scoparioides* Koch.)	3	17	...	...	...	...	...	...	...	...
Barnyard grass (*Echinochloa crus-galli* (L.) Beauv.)	43	13	...	...	...	...	...	...	...	1
Bindweed, black (*Polygonum convolvulus* L.)	2	...	...	...	...	...	...	...	...	...
Bird's-foot trefoil (*Lotus corniculatus* L.)	21	23	...	...	...	...	1	...	...	1
Black-eyed Susan (*Rudbeckia hirta* L.)	1	2	16	1	12	5	...	...	...	...
Black medick (*Medicago lupulina* L.)	13	28	3	37	1	...	...	6	1	2
Bladder ketmia (*Hibiscus trionum* L.)	2	...	...	...	...	...	...	...	...	...

Table I (*continued*).

Names of Foreign Seed.	Kind of Crop Seed.									
	Alfalfa.	Red clover.	Timothy.	Alsike clover.	Alsike and timothy mixture.	Redtop.	Hairy vetch.	White clover.	Kentucky blue grass.	Miscellaneous samples.
Number of samples examined	621	170	150	96	17	14	14	13	14	31
Blue field madder (*Sherardia arvensis* L.)	12	30	1	...	...	...	...	3	...	1
Blue grass (*Poa pratensis* L.)	...	...	13	3	1	...	...	1	2	4
Bull thistle (*Cirsium lanceolatum* (L.) Hill)	1	3	...	...	...	...	...	...	...	1
Burdock (*Arctium minus* Bernh.)	2	...	...	...	...	...	...	...	...	...
Bur clover (*Medicago hispida* Gaertn.)	3	...	...	...	...	...	...	...	...	...
Buttercup (*Ranunculus bulbosus* L.)	...	...	...	...	...	...	...	...	...	1
Canada thistle (*Cirsium arvense* (L.) Scop.)	2	14	7	18	3	...	...	...	1	...
Caraway (*Carum carui* L.)	1	...	...	...	...	...	...	...	...	...
Catnip (*Nepeta cataria* L.)	1	9	8	2	...	...	...	...	...	...
Chess; cheat (*Bromus secalinus* L.)	1	5	...	...	...	...	...	...	...	...
Chicory (*Cichorium intybus* L.)	65	27	1	...	1	...	...	...	...	...
Cinquefoil (*Potentilla canadensis* L.)	...	...	2	...	...	...	...	...	...	...
Cinquefoil (*Potentilla monspeliensis* L.)	...	...	51	4	14	5	...	...	1	4
Cleavers (*Galium aparine* L.)	...	...	...	...	...	...	4	...	...	...
Cleavers (*Galium mollugo* L.)	...	1	...	...	...	...	...	...	...	...
Cockle (*Agrostemma githago* L.)	...	...	...	...	...	...	10	...	...	...
Compositae, spp.	2	1	...	...	...	...	...	...	...	1
Corn chamomile (*Anthemis arvensis* L.)	3	5	3	6	...	...	...	2	...	1
Cow herb (*Saponaria vaccaria* L.)	2	11	5	1	3	...	...	...	...	...
Crab-grass, small (*Digitaria humifusa* Pers.)	2	11	5	1	3	...	...	...	...	...
Crab-grass, large (*Digitaria sanguinalis* L.)	1	4	...	...	...	...	...	...	...	...
Cranesbill (*Geranium carolinianum* L.)	1	1	...	...	...	...	...	...	...	...
Cranesbill (*Geranium dissectum* L.)	2	18	...	...	...	...	...	...	...	2
Cranesbill (*Geranium pusillum* Burm.)	2	8	...	...	...	...	...	...	...	...
Crimson clover (*Trifolium incarnatum* L.)	...	2	...	...	...	...	...	...	...	...
Dandelion (*Taraxacum erythrospermum* Andrz.)	...	...	...	...	...	...	...	...	...	1
Darnel (*Lolium multiflorum* Lam.)	...	2	...	...	...	...	...	...	...	...
Dock, curled (*Rumex crispus* L.)	71	130	1	1	...	...	...	...	...	...
Dock (*Rumex* spp.)	2	...	13	37	6	...	...	2	3	6
Dodder, clover (*Cuscuta epithymum* Murr.)	43	11	...	...	1	...	...	...	...	...
Dodder, field (*Cuscuta arvensis* Beyrich.)	41	22	...	...	...	...	...	...	...	...
Ergot (Sclerotia) (*Claviceps* sp.)	...	...	4	...	2	1	...	...	...	...
Euphorbia spp	1	...	...	...	...	...	...	...	...	...
Evening primrose (*Onagra biennis* (L.) Scop.)	...	1	9	...	2	1	...	...	...	...
False flax (*Camelina microcarpa* Andrz.)	1	1	7	8	5	...	...	...	...	2
False flax (*Camelina sativa* (L.) Crantz.)	5	...	1	2	1	...	...	...	...	3
Foxtail, green (*Chaetochloa viridis* (L.) Nash.)	315	142	25	23	5	...	...	2	...	4
Foxtail, yellow (*Chaetochloa glauca* (L.) Scrib.)	57	40	...	...	...	...	...	...	...	...

TABLE I (*continued*).

NAMES OF FOREIGN SEED.	KIND OF CROP SEED.									
	Alfalfa.	Red clover.	Timothy.	Alsike clover.	Alsike and timothy mixture.	Redtop.	Hairy vetch.	White clover.	Kentucky blue grass.	Miscellaneous samples.
Number of samples examined	621	170	150	96	17	14	14	13	14	31
Galium sp	2	...	...	...	...	...	...	...	...	...
Grass (*Poaceae* spp.)	49	21	16	8	1	...	...	1	...	3
Gum plant (*Grindelia squarrosa* (Pursh) Dunal)	8	...	...	...	...	...	...	...	...	...
Hare's ear (*Conringia orientalis* (L.) Dumort)	6	2	...	...	...	...	...	...	...	1
Heal-all (*Prunella vulgaris* L.)	14	65	12	12	2	...	...	1	...	1
Hedge mustard (*Sisymbrium officinale* L.)	...	...	2	1	...	1	...	...	...	2
Hoary cress (*Lepidium draba* L.)	2	...	...	...	...	...	...	...	...	...
Johnson grass (*Sorghum halepense* (L.) Pers.)	14	3	...	...	...	...	...	...	...	...
Kidney vetch (*Anthyllis vulneraria* L.)	2	...	...	...	...	...	...	...	...	...
Knot grass (*Polygonum aviculare* L.)	10	5	...	...	...	...	...	...	...	...
Lady's thumb (*Polygonum persicaria* L.)	4	33	...	...	...	...	...	8	...	2
Lamb's quarters (*Chenopodium album* L.)	187	57	33	10	4	...	...	...	...	1
Lentil (*Ervum lens* L.)	...	...	...	...	...	...	1	...	...	...
Mallow (*Malva rotundifolia* L.)	51	8	...	...	...	...	...	...	...	...
Mallow, false (*Malvastrum coccineum* Gray)	3	...	...	...	...	...	...	...	...	...
Mallow, whorled (*Malva verticillata* L.)	2	...	...	...	...	...	...	...	...	...
Malva sp	2	...	...	...	...	...	...	...	...	...
Maple-leaved goose foot (*Chenopodium hybridum* L.)	9	...	...	...	...	...	...	...	...	...
Marsh elder (*Iva xanthifolia* (Fresn.) Nutt.)	25	1	...	...	...	...	...	...	...	...
Marsh spike grass (*Uniola latifolia* Michx.)	1	...	...	...	...	...	...	...	...	...
May weed (*Anthemis cotula* L.)	...	12	4	7	4	1	...	1	...	1
Meadow fescue (*Festuca elatior* L.)	...	1	...	...	...	...	...	...	...	...
Melilotus spp	6	...	...	...	...	...	...	...	...	...
Melilotus, slender (*Melilotus gracilis* D. C.)	1	...	...	...	...	...	...	...	...	...
Millet (*Chaetochloa italica* (L.) Beauv.)	50	5	1	...	1	...	...	...	...	2
Moth mullein (*Verbascum blattaria* L.)	...	...	1	...	...	...	...	...	...	...
Mustard (*Brassica* spp.)	105	20	1	3	...	...	1	...	...	7
Mustard, black (*Brassica nigra* (L.) Koch.)	6	...	...	...	...	...	...	...	...	...
Mustard, tumble (*Sisymbrium altissimum* L.)	1	...	...	...	...	...	...	...	...	...
Mouse-ear chickweed (*Cerastium vulgatum* L.)	...	...	8	5	2	1	...	1	2	2
Narrow-leaved hawk's-beard (*Crepis tectorum* L.)	...	...	...	...	...	...	...	...	...	1
Niger seed (*Guizotia abyssinica* Cass.)	...	...	1	...	...	...	...	...	...	...
Night-flowering catchfly (*Silene noctiflora* L.)	25	49	10	36	5	...	...	9	...	3
Old witch grass (*Panicum capillare* L.)	7	10	2	3	5	...	...	1	...	...
Oxeye daisy (*Chrysanthemum leucanthemum* L.)	3	...	14	12	2	1	...	...	...	2

Table I (*continued*).

Names of Foreign Seed.	Kind of Crop Seed.									
	Alfalfa.	Red clover.	Timothy.	Alsike clover.	Alsike and timothy mixture.	Redtop.	Hairy vetch.	White clover.	Kentucky blue grass.	Miscellaneous samples.
Number of samples examined	621	170	150	96	17	14	14	13	14	31
Paspalum (*Paspalum setaceum* Michx.)	7	4	...	...	...	...	...	...	...	...
Penny cress (*Thlaspi arvense* L.)	1	...	...	...	...	...	...	...	...	...
Pepper-grass, apetalous (*Lepidium campestre* (L.) R. Br.)	1	10	1	7	1	...	...	...	...	...
Pepper-grass, wild (*Lepidium virginicum* L.)	5	3	67	11	11	3	...	2	6	1
Picris (*Picris hieracioides* L.)	10	22	...	...	...	...	...	...	...	...
Picris; oxtongue (*Picris echoides* L.)	11	33	...	...	...	...	...	...	...	...
Pigweed (*Amaranthus* spp.)	109	11	1	7	4	...	...	3	2	3
Pigweed, slender (*Amaranthus hybridus* L.)	11	30	...	...	...	...	...	...	...	.
Pigweed, rough (*Amaranthus retroflexus* L.)	1	1	22	...	...	...	...	...	...	...
Pimpernel (*Anagallis arvensis* L.)	...	1	...	...	...	...	...	...	...	...
Plantain, buckhorn (*Plantago lanceolata* L.)	163	137	26	51	15	3	...	8	5	7
Plantain, Rugels (*Plantago rugelii* Decne.)	...	32	25	6	6	5	...	3	...	2
Plantain, broad-leaved (*Plantago major* L.)	2	21	14	3	9	...	...	...	1	1
Plantain, large-bracted (*Plantago aristata* Michx.)	...	21	...	...	...	...	...	...	...	...
Poison hemlock (*Conium maculatum* L.)	2	...	...	...	...	...	...	...	...	...
Polygonum spp	34	18	...	...	...	...	...	...	...	...
Prostrate amaranth (*Amaranthus blitoides* S. Wats.)	11	1	...	...	...	...	...	...	...	...
Ragweed (*Ambrosia artemisiifolia* L.)	14	33	...	...	...	...	...	...	...	...
Red clover (*Trifolium pratense* L.)	61	...	54	61	7	1	...	7	1	2
Redtop (*Agrotis alba* L.)	7	...	17	9	13	...	...	1	...	3
Roquette (*Eruca sativa* Mill.)	29	...	...	...	...	...	...	...	...	...
Rush (*Juncus tenuis* Willd.)	...	...	...	...	...	5	...	...	...	...
Russian thistle (*Salsola kali tenuifolia* G. F. W. Mey.)	89	6	...	...	...	...	...	...	...	...
Rye (*Secale cereale* L.)	1	1	...	...	...	...	...	...	...	...
Sage, lance-leaved (*Salvia lanceaefolia* Poir.)	9	1	...	...	...	...	...	...	...	...
Sage, lyre-leaved (*Salvia lyrata* L.)	3	...	...	...	...	...	...	...	...	...
Salt bush; Orache (*Atriplex patula* L.)	117	3	2	...	...	...	...	...	...	...
Sand bur (*Cenchrus tribuloides* L.)	4	...	...	...	...	...	...	...	...	...
Serradella (*Ornithopus sativus* Butt.)	2	1	...	...	...	...	...	...	...	...
Sedge (*Carex* spp.)	5	7	26	4	12	4	...	2	14	2
Sheep sorrel (*Rumex acetosella* L.)	15	73	70	58	16	3	...	13	10	8
Shepherd's purse (*Capsella bursa-pastoris* (L.) Medic.)	1	1	3	4	...	...	...	3	1	...
Slender nettle (*Urtica gracilis* Ait.)	...	...	1	...	...	...	...	1	...	1
Smart-weed (*Polygonum hydropiper* L.)	7	9	...	...	...	...	...	...	...	...
Sorrel (*Rumex acetosa* L.)	5	...	...	...	...	...	...	...	...	...

TABLE I (*concluded*).

NAMES OF FOREIGN SEED.	KIND OF CROP SEED.									
	Alfalfa.	Red clover.	Timothy.	Alsike clover.	Alsike and timothy mixture.	Redtop.	Hairy vetch.	White clover.	Kentucky blue grass.	Miscellaneous samples.
Number of samples examined	621	170	150	96	17	14	14	13	14	31
Spring vetch (*Vicia sativa* L.)	...	...	...	...	...	...	12	...	...	...
Spurry (*Spergula arvensis* L.)	1	1	1	...	...	...	...	4	...	...
St. John's wort (*Hypericum perforatum* L.)	...	...	...	...	3	...	...	...	...	...
Star thistle (*Centaurea cyanus* L.)	1	...	...	...	...	...	...	...	...	...
Star thistle (*Centaurea jacea* L.)	6	4	...	...	...	...	...	...	...	...
Star thistle (*Centaurea picris* L.)	5	...	...	...	...	...	...	...	...	...
Star thistle (*Centaurea repens* L.)	50	2	...	...	...	...	...	...	...	...
Star thistle (*Centaurea solstitialis* L.)	5	3	...	1	...	...	...	...	...	...
Sow thistle (*Sonchus oleraceus* L.)	...	...	...	1	...	...	...	...	...	...
Stick-seed (*Lappula echinata* Gilibert)	14	17	...	3	...	...	...	...	...	...
Stink-grass (*Eragrostis megastachya* Link.)	1	...	...	...	...	...	...	...	...	...
Sulla (*Hedysarium coronaria* (Tourn.) L.)	5	...	...	...	...	...	...	...	...	...
Sweet clover (*Melilotus alba* Desr.)	63	2	...	...	...	...	...	...	...	...
Switch grass (*Panicum virgatum* L.)	2	...	...	...	...	...	...	...	...	...
Timothy (*Phleum pratense* L.)	101	68	...	84	...	9	...	5	...	9
Trionema monogyna L.	6	...	...	...	...	...	...	...	...	...
Vervain, blue (*Verbena hastata* L.)	...	11	1	...	...	1	...	...	...	...
Vervain, white (*Verbena urticifolia* L.)	...	1	1	...	1	...	...	...	...	...
White clover (*Trifolium repens* L.)	15	35	34	69	8	4	...	...	7	5
White hoarhound (*Marrubium vulgare* L.)	1	...	...	...	...	...	...	...	...	...
Wild buckwheat (*Polygonum convolvulus* L.)	5	3	...	...	...	...	...	...	...	...
Wild carrot (*Daucus carota* L.)	25	40	...	3	...	...	...	...	...	2
Wild lettuce (*Lactuca canadensis* L.)	1	...	...	...	...	1	...	...	...	...
Wild radish (*Raphanus raphanistrum* L.)	1	...	1	...	...	1	...	...	...	1
Wild vetch (*Lotus americanus* (Nutt.) Bisch.)	...	...	...	...	...	...	1	...	...	4
Willow herb (*Epilobum angustifolium* L.)	...	...	8	...	1	1	...	...	...	...
Yarrow (*Achillea millefolium* L.)	1	8	2	1	2	3	...	...	...	...
Yellow chamomile (*Anthemis tinctoria* L.)	...	...	...	1	...	...	...	...	...	...
Yellow rocket (*Barbarea barbarea* (L.) MacM.)	1	2	4	11	1	...	...	1	...	...

THE PRICE CONTROL FACTOR IN THE PURE MILK PROBLEM.*

F. H. HALL.

Good milk demands a good price.

Under present conditions, dairymen cannot profitably produce good, sanitary milk to sell at wholesale for much less than four cents a quart. Many researches, made in several states, with data and estimates obtained from widely varying sources, unite upon approximately this figure. For example, in a study of the milk supply of an adjoining city of about 12,600 inhabitants, made by the bacteriologist of this Station, the following figures were secured for the investment required to supply the city with milk:

CAPITAL INVESTED IN SUPPLYING MILK TO CITY WITH 13,000 INHABITANTS

Cows — 600 at $80	$48,000
Land with buildings — 3,000 acres at $100	300,000
Equipment — 3,000 acres at $20 per acre	60,000
City distributers	50,000
Total	$458,000

These figures are based upon most careful, conservative estimates and are believed to be below the actual figures that would be shown by a detailed census. This would place the amount of capital invested for each cow at $680 for the producer and $83 for the retailer. The 600 cows in the dairies supplying this city give annually approximately 2,800 quarts of milk each, a figure decidedly better than the average for the State, which is about 2,100 quarts. The Station herd for several years produced almost exactly 2,800 pounds per cow. Accurate records of the food cost required to produce the milk

* Reprint of Popular Edition of Bulletin No. 363; see p. 37 for Bulletin.

in this herd for several years previous to 1908 showed that cost to be steadily increasing so that in that year it was 2.09 cents per quart. The producer must meet this expense and should be entitled to 6 per ct. interest on his capital of $680 per cow. This adds 1.45 cents per quart, making 3.54 cents for two items only. If the dairyman gets only 3½ cents a quart for milk he must pay, from the veal sold and the manure produced, a little loss on each quart of milk as well as the expense for labor and supervision. At 4 cents a quart, he has a margin of less than half a cent a quart, with the veal and manure, to meet these necessary expenses and provide a profit. The average producer "continues in business because he accepts less than 6 per ct. upon his capital invested. His financial salvation depends upon increasing the productivity of his land to the point where it takes less than five acres to support a cow and increasing the productivity of his cows so that they will produce more than 2,800 quarts per year. A part of the solution of his difficulties lies in the possibility of an increased wholesale price for his product."

Expensive to make sanitary milk.

Even with a fair wholesale price for his product the dairyman must handle each detail of his equipment with an eye to economy if profit is to be secured. If there be enforced upon him a demand for a product better than the average, a product made and handled under good sanitary conditions, his expenses must necessarily rise and his margin of profit be lessened or disappear unless he receives for the better product a correspondingly higher price. To assure the producer of a price corresponding to the nutritive and sanitary quality of his product is the best means of securing improvement.

Publicity and price control raise quality.

This was very strikingly shown in Bulletin 337 of this Station. In that Bulletin are given the details of a movement, in the city before referred to, to secure a better milk supply. By the passage of certain ordinances, supervision of the city milk supply was given to the Board of Health, which was authorized to have the dairies supplying milk to the city inspected and to publish quarterly reports upon their condition. A sanitary inspector was appointed to make the inspections, using as his guide the Cornell University dairy score card; and the ratings of the points on the cards were made by the Station bacteriologist, as a member of the Board of Health. Influenced by publicity alone, the sanitary conditions of the dairies improved; and when, a little later, the milk handlers of the city united and agreed to pay producers for the milk according to ratings based on the official score cards, advancement was rapid. "Poor milk," that is, milk from dairies scoring below 400 score card points, was not accepted at all; for "medium" milk, from dairies scoring 400 to 450 points, 3 cents a quart was to be paid; for "good" milk (450 to 480 points) the price was to be

3½ cents; and for " excellent " milk, from dairies scoring 480 points or more, 4 cents was to be given.

By the united influence of the two factors, publicity and payment based on quality, an astonishing change was made in the quality of the city milk supply. When the work began, 90 per ct. of the milk sold came from dairies in the " poor " or " medium " class, only two of the 40 sources of supply scoring more than 450 points, or " good." In three years and a half, these figures were much better than reversed; for at the end of that time one-eighth of the dairies, furnishing two-fifths of the milk, were in the " excellent " class and all the others in the " good " grade, both poor and medium dairies having ceased to exist as sources of supply.

Which factor was most effective, the publicity or the bonus given for improved quality, could not be determined; but that the financial stimulus was largely responsible is shown by a later development of the milk situation in the same city.

Change in conditions.

The inspector selected by the Board of Health from a list provided by the city Civil Service Commission was not well qualified by training or experience for the position, but he rapidly improved under the instruction of the Board of Health member in charge, especially after taking a " short course " in dairying at Cornell University and eventually became an efficient inspector.

Early in 1911 the member referred to above withdrew from the Board of Health and later in the year the dairy inspector resigned to enter the postal service.

The vacancy in the position of dairy inspector has since been twice filled by the board of health from eligible lists furnished by the civil service commission. Neither of these inspectors has had anything which could reasonably be considered as a preparation for the technical work of sanitary scoring of dairies.

The character of these appointments and the results upon the milk situation which followed them indicate clearly that there must be a radical change in the prevailing point of view regarding the qualifications for municipal appointments before we shall have a public service which will command the respect and cooperation of the milk producers and retailers. Without such respect and co-operation practically nothing can be accomplished.

The position of an untrained inspector, made responsible for dairy scoring when the financial importance of his scoring is so great, was not an enviable one.

Effect of change.

His main source of guidance was the detailed scores of the dairies as they had been given by his predecessor. It was a natural assumption that these scores were fairly correct measures of the existing conditions. Under such circumstances fine distinctions were impossible and it was the natural tendency to repeat the gradings previously given.

The results of the inspections as given by the quarterly reports of the Board of Health indicated that the sanitary conditions surrounding the production of the milk supply had remained practically unchanged, the report for December 31, 1912, showing 10 per ct. of the dairies as " excellent " and 90 per ct. as " good." These reports were gratifying to the public since they indicated the continuance of satisfactory sanitary conditions and they were satisfactory to the producers since they insured the continuance of the prevailing prices for milk.

But subsequent investigations made by the Station, in following out other lines of work, indicate that conditions in many of the dairies were not accurately shown by the reports. The Bacteriological and Dairy Departments of the Station are engaged in a comparative study of various score cards. In August, 1912, they were being aided in this study by Mr. F. H. Bothell, of the Dairy Division of the U. S. Department of Agriculture, a man of wide experience in the sanitary scoring of dairies. In company with Mr. Bothell, the station bacteriologist, Dr. H. A. Harding, one of his assistants, Mr. Jas. D. Brew, and Mr. Geo. A. Smith, the Station dairy expert, inspected 15 of the dairies supplying this city, in connection with these score card studies. At this time it was evident that, notwithstanding the favorable reports given by the city inspector, the sanitary conditions surrounding the milk production had deteriorated very markedly.

The conditions were again determined by an inspection of the dairies by Mr. Brew during the last quarter of 1912, and all of the dairies were again visited during January and February of 1913. In each case the facts as they existed were noted at the time of the visit and the reduction of this to a numerical score was supervised by Dr. Harding. Using the same standard of cuts and making the scorings in all particulars as comparable as possible with the scoring made in March, 1911, when the results were 12.8 per ct. " excellent " and 87.2 per ct. " good," the inspections made in January and February, 1913, gave 18 per ct. " good " and 82 per ct. " medium."

The magnitude of this change in conditions is shown graphically by the diagrams on the title page.

The nature of these changes in sanitary conditions is extremely suggestive. In a number of cases the tuberculin test was not renewed within the year and the reacting animals removed; the cleaning of the cows was generally omitted and in some cases their bodies were allowed to become well coated with dried excrement; frequently little or no attention was given to the cooling of the milk; cobwebs, dust and general litter accumulated in the stables; the barnyards often became choked and muddy from the accumulation of manure. It should be noted that the failure to attend to these details saved

How decline occurred.

money or saved labor, which, under present conditions, amounts to the same thing to the producer. It should also be noted that with the exception of the tuberculin test there was no single day when any one of the above conditions could have been said to have changed from good to bad. The resulting bad conditions were the cumulative result of a gradual lowering of the standard of doing business.

In attempting to locate the cause for this marked deterioration in sanitary conditions it should be remembered that not a letter of the city milk ordinances has been changed, that the form of milk inspection has been continued, that the milk is still sold by the producer to the retailer under the same form of contract which was in force when advancement was most rapid. In short, every external form and legal enactment which accompanied one of the most striking recorded cases of municipal improvement of a milk supply is still in force and yet within less than two years the sanitary conditions surrounding the milk production have returned essentially to the condition in which they were at the beginning of the original improvement.

Cause of change in sanitary conditions.

Under the sliding scale contracts as explained on page 4 the wholesale price of milk increased one-half cent per quart in passing from " medium " to " good " or from " good " to " excellent." As explained in Bulletin 337 the increased expense connected with bringing a dairy ranking as " medium " into the " good " class was ordinarily confined to that of the labor connected with keeping the cows and their surroundings cleaner and in cooling the milk. As the production of " medium " milk at 3 cents per quart was financially unprofitable and the expense attending the change to the " good " grade amounted to less than one-half cent per quart the dairies all came up to the " good " grade. In bringing the dairy up to the " excellent " grade the farmer not only incurred an increased expense for cleanliness and cooling of his milk but also faced the problem of maintaining a herd which would pass the tuberculin test. The extent of loss in connection with reacting animals was so uncertain that the majority of the farmers hesitated to take the chance even with a margin of one-half cent per quart. So far as information is available all those who took the chance found it financially profitable.

The situation which existed during 1911 may be summarized by saying that the farmers produced fairly sanitary milk because it was the quality which they could produce most profitably.

Under conditions which existed during the latter part of 1912, when the official grading of the dairies merely retained them at the highest grade which they had previously reached, the financial stimulus for the production of cleaner milk was weakened if not entirely removed. Although the farmers exercised progressively less

care in the production of milk they suffered no financial penalty. While the retailers were aware that the sanitary quality of the product as furnished them was deteriorating they could make no effectual protest since they were bound by their contracts to accept the official score as the basis for payments.

The former system of wholesale prices according to which milk was bought by weight or measure regardless of its commercial quality practically compelled the production of the cheapest and dirtiest possible supply.

Conclusions.

At present prices the margin of profit in the production of milk is so narrow that the farmers can not afford to act the part of philanthropists by the production of a higher grade of milk than the market demands and is willing to pay for.

On the other hand the farmers have a business sense which quickly leads them to produce the grade of product for which they can obtain the largest margin of profit.

The important fact which stands out clearly in the present situation is that while the farmers are able and willing to produce a sanitary milk whenever such produccion is the more profitable they can not be expected to continue such production whenever there is greater p ofit in the making of dirtier milk.

The lessons which have been taught by this five years' study of a municipal milk supply indicate fairly clearly that the farmers are prepared to produce any grade of milk which the market desires. They will produce it as soon as the market clearly states its wants and offers a price which will make the production reasonably profitable.

Under present conditions there is a demand for milk for three distinct purposes: for the feeding of infants, use by adults at table, and for cooking. The simplification of the municipal milk problem lies along the line of defining and establishing commercial grades of milk which shall correspond to these market demands.

Whenever it becomes possible to buy milk by such grades and feel sure that the milk is true to grade the supply upon the market will become just as clean and pure as the purchasing public desire it to be.

SOME GOOD FRUITS RECENTLY GROWN.*

F. H. HALL.

New varieties necessary in fruit growing. For improvement in fruits the grower must depend upon new varieties. Old varieties probably do not deteriorate, if properly handled, but they do not improve or change except in very rare instances. The varieties we have are far from perfect and it is the ambition of almost every grower to produce something better in some one or more respects than even those varieties he prizes most highly. Consequently, each year, there appear in the nurserymen's catalogues or in pomological literature descriptions of many new kinds of fruit. In many cases, the originator, or introducer, sees in the foreground the good qualities of the new variety and may praise it overmuch or recommend it for more general planting than the truth warrants.

Impartial testing necessary. For the good of the fruit-growing industry, therefore, it is desirable that some unprejudiced authority should test new fruits, and weigh with judicial hand both their merits and their defects. This is one of the functions of an experiment station, and this Station has, almost from its foundation, collected, grown and compared fruit varieties. Among those tested are several new kinds, which seem worthy of recommendation, as they are better in some quality than somewhat similar varieties, or at least sufficiently different in character, productivity or season to fill a desirable place in the pomology of the State. Some old kinds also have proven so good at the Station that it seems worth while to bring them again, and somewhat forcefully, to the attention of fruit-growers. These old

* Reprint of Popular Edition of Bulletin No. 364; see p. 442 for Bulletin.

varieties may have become obscure because never properly introduced by the originator, or because once hampered by some defect easily controlled by modern methods. Some of these old varieties are worthy of as much attention from the grower as some of the novelties of today. It is proposed in this popular edition to call attention but briefly to some of the qualities of these varieties, but full descriptions will be found in the regular edition of the bulletin.

APPLES.

Deacon Jones. For a general purpose, market apple, *Deacon Jones* is well worth trial and is attracting considerable attention in western New York. It is a large apple, somewhat resembling Bellflower in shape, handsome when well colored, of good, though not high quality, of mild flavor, and of rather coarse texture. The ground color is yellow, which is overlaid with an attractive red relieved with numerous prominent dots. The skin is tough, which, with the firm texture of the flesh, makes the apple a good shipper. It hangs exceptionally well to the tree so that there is little waste from windfalls and culls. The tree is thrifty in both nursery and orchard, and bears early, annually and heavily.

Delicious. Probably no new apple has been more widely talked about, more generally planted, or better received than *Delicious*. In New York, the apple is somewhat smaller and not quite so highly colored as in the orchards of the west and northwest where it is proving a great commercial success, but the rich, distinctive flavor of this fruit develops even better in the orchards of the State. This quality, with the beautiful color of the apple, recommends it for every home orchard and justifies its trial in an experimental way for the commercial grower. The fruit is large, somewhat conical in form, with light yellow ground color, nearly or almost entirely overspread with dark, attractive red, splashed and mottled with carmine, and the flesh is pleasantly subacid, tender, juicy and aromatic. The defects of the apple noted in New York are susceptibility to water-core and to softening of flesh about the core and readiness to infection by the spores of apple scab.

Opalescent. We know of no apple that can be grown in New York better endowed with characters fitting it to compete with the showy fruit from the west than Opalescent, one of the most attractive apples known. It is large, shapely, nearly or quite covered with brilliant red on a yellow background, a veritable feast to the eye. In quality, too, it is excellent, but its season is rather short for a commercial variety, as it ends in January, yet it should prove a profitable apple for the fall and early winter. The young trees on our grounds are hardy,

vigorous and productive — all characters thus marking it as a promising variety for New York fruit-growers.

PEAR.

Lucy Duke.

Why the *Lucy Duke* pear has been so neglected is hard to see, for Thomas Meehan said of it twenty-five years ago, " It is the finest large pear in cultivation ", and Charles Downing thought it " Not quite so fine as a first-class Seckel, but I must aver it is not far behind." Its rich, juicy, spicy, melting flesh makes it of the very finest quality. In form, it resembles Bartlett, one parent, is of medium size and of a beautiful golden russet color, which makes it extremely handsome. It can be unqualifiedly recommended for local and fancy markets and its rather thick skin would indicate good shipping quality, and if sufficiently productive — as it has been on the Station grounds — it may become a good market variety. The tree is hardy and productive, though only moderately vigorous, resembling its other parent, Winter Nelis, somewhat in habit of growth. It is said to be blight proof; and its parentage and successful development in the south, where only a blight-resistant pear could succeed, would indicate relative immunity to blight.

PEACHES.

Arp Beauty.

Many admirable qualities are combined in *Arp Beauty*. It is the earliest good yellow peach, coming to maturity a month to five weeks earlier than Elberta and lasting for a remarkably long season for a variety so early. Its round-oval shape and shallow suture make it very pleasing in form. Its skin is creamy and yellow with a heavy blush of red and with a thick cover of short pubescence having the sheen of velvet, altogether making it a beautiful peach. The flesh is light yellow, firm, juicy, sweet, rich and of excellent quality, but unfortunately clings rather tenaciously to the stone. At the Station the trees are healthy, vigorous, productive and hardier in bud than the average, its buds having withstood the cold of the severe winter of 1911 and 1912, which spared few other varieties. The shipping qualities of the fruit have not been well tested here, but it seems as suitable for this purpose as any of the standard varieties. It may be well adapted for market purposes and it certainly should be in every home orchard.

Frances.

Of all varieties advertised to follow Elberta in the markets, *Frances* is the best peach grown on the Station grounds. Its fruits are practically as large as those of Elberta and even more handsome, with a richer background of yellow and more brilliancy in its red cheek, more nearly round and more uniform in size and shape. Its quality is

much the same as that of Elberta, but the advantages — slight though they may be — in flavor, texture, juiciness and general palatability, are all in favor of Frances. It extends the Elberta season a few days or a week, which gives it its chief right to a place in New York pomology. On our grounds it appears to be quite as good for market purposes as Elberta, but it has not yet proven so adaptable to all peach environments, possibly because not yet tested as widely as Elberta. The trees are vigorous, productive and hardy, as the buds withstood the winter of 1911–12 better than did those of Elberta.

Miss Lola. On our grounds, *Miss Lola* is the best peach of its season and one of the best of all. It follows Mamie Ross and Greensboro, while it precedes Champion and is better in appearance and quality than any of these varieties. Miss Lola is almost a freestone, the flesh clinging even less than that of Champion, as the two grow at the Station. It is of better quality and a little larger than the well-known Carman, with which its season makes it a competitor in the market, but it is hardly as well colored as that variety. Its trees are hardier in bud than the Carman, and, on our grounds, more productive.

PLUMS.

Imperial Epineuse. The plum known as Clairac, or Clarice, Mammoth is properly the *Imperial Epineuse* and is one of the most promising plums grown on the Station grounds. It is unsurpassed by any other purple plum, is one of the largest in the prune group and one of the most attractive, by reason of its well-molded form and its handsome, varying reddish-purple color. The trees are of exceptionally good character, being vigorous, hardy and strong, upright growers. The plums are borne on the main limbs and are thus protected from the sun. We believe this a desirable market plum for New York.

Middleburg. It is quite remarkable that so good a plum as *Middleburg* should be so little known as is this variety. Though it has been in existence three-quarters of a century, the name is not mentioned in any pomological text book, yet few plums of its color and season are better in quality either for dessert or for cooking. Its appearance does not specially commend it, but none of several other good late-ripening sorts surpass it in some respects, as in hanging to the tree, in long keeping, or in quality. The trees are only of medium size, but are robust, healthy, hardy, productive and very free from black knot, while the fruit is less affected by brown rot than that of any other Domestica plum. It is certain that Middleburg should be in every collection for the home orchard, and it is probable that it can be grown profitably for the market.

Pearl. The rich golden color, large size, fine form, melting flesh and sweet, luscious flavor give *Pearl* a place among the best dessert plums. It is surpassed in quality by no other plum in the Station collection. The variety lacks a little in the character of the trees, as these, though vigorous, healthy, seemingly hardy, and of fair size, are not quite satisfactorily productive. If the defect of unproductiveness can be overcome by growing Pearl on other soils, or under different environment, it becomes a plum of great value. It can certainly be profitably grown for local markets and can be most highly recommended to all who grow fruit for pleasure. Its shipping qualities have not yet been tested, but it will probably ship as well as Reine Claude, which it resembles in many respects.

Tennant. While the *Tennant* plum is not of sufficiently high quality to be called a first-rate dessert fruit, it may be rated as far above the average and as well toward the top among purple plums. In the Station collection, the variety is prominent in size, beauty of form and in color. It ripens a few days before the well-known Italian prune and is said to ship and keep well in the Pacific Northwest, where it has long been grown and esteemed. The tree is ideal — large, vigorous, healthy, hardy and productive, unexcelled in general habits by any other variety. *Tennant* should be very generally tried in commercial plantations in New York and a few trees should be planted in every home orchard.

CHERRY.

Schmidt. About Geneva, where many sweet cherries are grown, *Schmidt*, better known as *Schmidt's Bigarreau*, is one of the best market varieties, but in New York State, as a whole, it has not received the attention it deserves from commercial cherry growers, as it is placed behind ten or a dozen other kinds, when it should be in the front rank. The characters which entitle it to first place as a money-maker are: Largeness, since it is unsurpassed in size by any other black cherry in this region; its round, plump form and glossy black color, which tempt the eye; crisp, firm, juicy flesh and sweet, rich flavor, delicious to the taste; dark ruby-red color under the skin, which makes it as pleasing inwardly as outwardly; freedom from brown-rot, in this respect excelling any other market sort; and vigor, productiveness and health of the tree.

GRAPES.

Berckmans. The offspring of two good varieties, Delaware and Clinton, the *Berckmans* grape unites in some degree the good points of its parents. It is not quite so good in quality as Delaware, but it does not fall far short in tenderness, sweetness and richness, while it keeps and ships better

than the fruit of that variety. In vine characters, it resembles the Clinton, being hardy, vigorous, comparatively free from mildew and well suited to many kinds of soil; that is, it does not color well in an environment to which it is not adapted. In popular opinion it ranks only as a grape for the amateur, but from its behavior on these grounds, it would seem certain that it has value in commercial plantations wherever Delaware is grown, particularly as a grape for local markets.

Delago. The old *Delago* has almost passed from cultivation, but should be retained for at least two qualities. It is one of the latest keeping grapes out of the collection of four or five hundred grown on our grounds and has the firmest flesh of all American grapes. It is of very good, though not the highest quality, being a little too tart and slightly lacking in richness. The bunches and berries are intermediate in size and color between those of the parents of the variety — Delaware and Goethe. It ripens late and should not be planted where the Catawba can not be grown, but under proper conditions, with a careful study of its needs, it should make a splendid late-keeping grape for the fancy market. It is certainly worth cultivation by the amateur who wants grapes in midwinter.

Eclipse. In a collection of over four hundred kinds, *Eclipse* is the only new grape that we can unqualifiedly recommend fruit-growers to test. The vines are hardly surpassed by those of any other variety, being hardy, healthy and productive, holding the ripe fruit for some time without deterioration and without cracking in wet weather. It resembles Concord in bunch and berry, though both are a trifle smaller than in that variety, but it is of much better quality than Concord and ripens earlier. It should make a splendid forerunner of that standard sort.

Secretary. Though an old grape now scarcely grown, few varieties have more good characters to commend them than *Secretary*. It is of exceptionally high quality, the berries are firm, meaty and yet juicy, fine-grained and tender, with a sweet, spicy, vinous flavor. The bunches are large, well-formed, of medium size and composed of purplish-black berries covered with thick bloom which makes it a most handsome fruit. The vines, however, lack a little in hardiness, vigor, productiveness and health, being considerably injured by mildew and black-rot. Despite these latter defects, Secretary has so many good qualities that we strongly recommend its culture both to amateurs and to those who are willing to give special attention to producing a fancy market grape.

RASPBERRIES.

June. The Station seedling, *June*, has now been tested long enough in different parts of New York State to prove it quite equal and often superior to the best older varieties. The plants are as hardy and as healthy as those of its two well-known parents — Loudon and Marlboro — and are more vigorous. Comparatively few suckers are produced, and these are placed well apart and thus better able to mature the crop. The yield is heavy and is well distributed over a long season, which begins the earliest of any of the seventy varieties growing at this Station, ripening, as its name indicates, in June. The fruit resembles Loudon in color — a bright handsome red — and averages larger than Cuthbert, but is more spherical in form. The berries hold up in size unusually well throughout the season, ship well and are high in quality. We expect to see this variety become one of the most profitable red raspberries grown.

Plum Farmer. How long it will maintain its good character and high position is a question, since black raspberries are subject to many diseases and varieties frequently run out; but at present, *Plum Farmer* is the best fruit of this type grown on the Station grounds and very favorable reports are received of its behavior in other sections. The plants are vigorous, healthy and hardy, since they were little injured by the unusually severe winter of 1911–12. The fruit is large, about the size of Gregg, of good color, high quality and well adapted to shipping. Its season is early as it ripens a week or more in advance of Gregg. It is a splendid new fruit, well worth testing.

CURRANTS.

Perfection. Though a comparatively new variety, the *Perfection* currant is already of commercial importance in New York State, but it deserves the attention of all growers of small fruits. It is of an attractive red color, slightly larger in both berry and cluster than the Fay currant, and superior to Fay or Cherry in flavor and quality. The berries are uniformly large to the tip of the cluster, and the base of the stem is free from berries, making it very easy to pick.

Diploma. The productivity, attractiveness and quality of the *Diploma* currant make it well worth planting in this State. Its berries are borne in long clusters, light red, with a thin transparent skin, a very juicy pulp slightly tinged with red and mild in flavor. It must be handled with care because of its thin skin and juiciness, but when picked and packed properly will, doubtless, ship long distances in good condition.

GOOSEBERRY.

Poorman. A gooseberry which should aid the present revival of interest in this fruit is the variety *Poorman.* This is an American variety whose plant and berries have given it a place as leader among the sixty kinds grown at the Station. The past season one bush produced seven and one-half pounds, and another nearly eight pounds, of fruit. The plants are large and vigorous and the berries larger than Houghton or Downing, more oval in shape and, at maturity, develop a very attractive red color. The quality is excellent.

STRAWBERRIES.

Prolific. A seedling strawberry developed at the Station, *Prolific,* has already attracted the attention of growers and is considered by many so desirable a commercial variety that it is being planted extensively. The plants increase rapidly and are as vigorous as those of either of its two well-known parents, Sample and Marshall. The blossoms are perfect. The plants have yielded at the rate of 15,000 quarts per acre. The fruit matures in mid-season and the large, firm, well-colored, well-shaped berries are produced in great numbers, holding up in size unusually well throughout the season. In color, Prolific resembles Sample rather than Marshall. The flesh is pleasantly acid and of good flavor and color. The vigor and productiveness of the plant and the attractiveness of the berry make Prolific well worthy of commercial planting.

Chesapeake. The most valuable asset of the strawberry *Chesapeake* is high quality, in which it is hardly surpassed. The dark red flesh is aromatic, highly flavored and mildly acid so that the taste confirms the verdict of the eye as it rests upon the plump, glossy, attractive exterior of the berry, with its large, leafy calyx. Chesapeake ripens just before Gandy. Taken all in all, it is one of the most promising of the comparatively new strawberries.

SOME UNESSENTIAL DAIRY REFINEMENTS.*

F. H. HALL.

Economy essential in dairying

Strict economy is necessary at every point if present-day milk production is to show profits. Advances in the price of purchased feeds and of labor have been accompanied in New York State, during several recent years, by short pastures and lessened yields of home-grown feeds due to droughts and other unfavorable weather conditions. At the same time, those having oversight of the large milk markets have demanded improvement in the sanitary quality of the milk that can only be secured by direct expenditure of money and by added labor in stable and milk room.

We must bear as best we may the calamitous vicissitudes of the weather, for we can usually do little to prevent or to replace the losses due to severe drought or untimely frost, but we may meet the demands for clean milk with much less labor than at first seemed possible. In large dairies, use of the milking machine may reduce the labor cost of milking while the germ content of machine-drawn milk — the measure of cleanliness in its production — may be held at a low point if a few simple, inexpensive precautions are observed. In smaller dairies where use of the machine is not practicable, the substitution of the small-top pail for the type in common use will shut out one-half or more of the dirt and germs that make milk impure without noticeably increasing outlay or labor.

Care in handling the milking machine and use of the small-top pail are practical sanitary measures which return marked results for the money and time expended.

Some resultless requirements

But boards of health and similar inspection officials include many other features in the requirements or recommendations for securing milk of good sanitary quality. These requirements have been based on general principles rather than actual measurements, for when the need for some regulation of the

* Reprint of Popular Edition of Bulletin No. 365; see p. 51 for Bulletin.

sanitary quality of milk arose, careful studies of the effect of various barn and milk-house conditions and of the various operations involved in getting milk from the cow to the consumer had not been made. Several of these recommendations or requirements, when tested at this Station and measured by their actual effect on the germs in the milk, prove of surprisingly little or no value. To secure some of the conditions in question, or to perform the operations involved, requires considerable expenditure of money or time; and proof that these conditions or operations are useless in improving the sanitary quality of the milk should result in the abandonment of demands for them by milk dealers and sanitary inspectors and remove them from dairy scorecards or greatly lessen their weight thereon. The milk producer can then devote to more profitable uses the money and time expended on these unessential refinements.

The tests discussed in this bulletin were made in the cattle barn of this Station, in which milk of good sanitary quality has been quite easily produced in recent years. The conditions are probably better than those in most farm-dairy stables, though there is no considerable difference between our stable and its equipment and those of other dairymen in the vicinity and throughout the State who are producing milk of the better grades. Whether the changes in the stable and its management, found without value here, would be equally valueless in stables of lower grade could only be determined by actual test, but in stables of such character other fundamental improvements should first be made if sanitary milk is to be produced; which would bring these stables out of the lower class.

The dairy operations found in our tests to have no value in keeping down germ content of milk were: (1) Ceiling the stable with lath and cement, and white-washing the interior and painting the woodwork; so that it may be said that the cleanliness of the interior of the stable, within a fairly wide range, had no measurable effect upon the milk. (2) Clipping the udder, flank and adjoining portions of the cow led to a slight increase in the germ content of the milk when the cow was cleaned either by hand or with a vacuum cleaning machine. (3) Cleaning the cows with a vacuum cleaner, at the rate of one cow per minute, resulted in practically the same germ content of the milk as cleaning with a brush and comb at the rate of two cows per minute.

Conditions of the tests

Study of some of the points here discussed began about five years ago and each test was continued long enough to obtain accurate results independent of accidental variations. In all the tests, small-top pails were used. In each case where only one cow was milked into a pail, the pail was thoroughly cleansed and sterilized in the dairy room about twenty rods from the barn and was

protected with a cloth over the top during the sterilization, this cloth not being removed until the pail was handed to the milker. In this way considerable contamination of the milk was avoided. In a preliminary test, we compared, for three milkings of each of four cows, pails thus protected by cloth and other pails similarly cleansed and sterilized, but not protected by the cloth while being taken from the milk room to the barn. The protected and unprotected pails were used alternately on the same cow by the same milker and all other necessary precautions were adopted to make the comparison show only the effect of the cloth protector. The average germ content shown in the protected pail was about 900 germs per unit,[1] while that in the unprotected pails was 160 per ct. greater, being about 2,400. This protection of the pails seemed of decided advantage in eliminating a source of error in the experiment and might be a wise precaution in practical dairy work. However, the influence of the protection would rapidly decrease with successive milkings into the same pail.

In taking samples, the milk from each cow was thoroughly stirred with a sterile spoon and the necessary amount taken by means of the same spoon. Before adopting this method of sampling careful tests were made of various other methods and this one was proven most reliable. Several duplicate bacterial cultures were made from the samples, which were developed under conditions providing both for the growth of the bacteria that thrive in ordinary room temperature and those coming from the udder of the cow where the temperature is considerable higher. In every case, at least three plates were counted to secure the average germ content, and, in many instances, twice this number.

Plastering and white-washing stable

When the Station barn was constructed in 1904, the cow stable was ceiled at the top and sides with planed, beaded, matched southern pine, which was finished with a coat of oil and shellac in accordance with accepted dairy construction at the time. Modern sanitarians find fault with this finishing of the stable since the joints and beading of the wood allow considerable accumulation of dust, and they usually recommend the use of lath and cement. This gives a tight ceiling and a smooth finish to which little dust can cling. In our stables, also, the stanchions are not of the type now most highly recommended, as they lack a little in simplicity and afford many places for the lodgment of dust. In order to contrast the effect of this older construction under unfavorable conditions with the newer construction at its best, dust was allowed to accumulate on walls, ledges and stanchions until these were in as bad a condition as would be tolerated under reasonably good barn management. The germ content of the milk of six cows,

[1] The unit was 1 cubic centimeter of milk, equal to 18 to 20 drops.

well distributed about the stable, was now determined at each of six milkings, three cows being milked by two men, each milker using the same pail. The interior of the stable was then thoroughly renovated, the ceiling and walls down to within three feet of the floor were covered with wire lath with two coats of cement and the area between the cement and the floor was covered with zinc. After the plastering had been finished, the stanchions, floors and mangers were thoroughly cleaned, thus putting the stable in excellent sanitary condition. As soon as the barn was in order, the germ content of the milk from the same six cows was again ascertained on six days. During this test, every effort was made to conduct all the operations connected with the barn management and the examination of the milk under conditions identical with those of the earlier test, except for the renovation of the stable which had taken place. Soon after this test was completed, the wood work and iron work of the stable were painted. When the stable was again ready for use, the germ content of the milk of the same cows was again determined. The results from the 212 milk samples show no measurable effect from the change in barn conditions. Taking as a basis the results obtained in the dirty barn before plastering, the milk obtained after the barn had been freshly plastered and cleaned showed an increase in germ content of 114 germs per unit, while later, when the wood work and stanchions had received a coat of paint, the germ content was 119 per unit less than when the barn was at its worst.

In previous studies made at the Station, it was found that the udders of different cows normally contained quite widely varying numbers of bacteria and that the number of bacteria found in the strippings, or last milking drawn from each cow, gives a very fair measure of these bacteria in the udder. In these three tests, samples were taken from the strippings as well as from the whole milk so that correction could be applied for the bacteria of the udder. If the figures as obtained from the whole milk are thus corrected to account for the udder content of bacteria, which could not have been directly influenced by the barn conditions, the results show that the increase in the germ content of the milk during milking was greater by 44 per unit after plastering and less by 137 after painting. What these results really show is that in the last two sets of tests when the barn conditions were essentially alike and unusually clean, the observed difference in germ content is much greater than the difference between the results when the barn was clean and when it was dirty. That is, the influence of the barn conditions was so slight that it was not measurable even when care was exercised to balance all of the other factors as closely as possible.

A little more than a year after this renovation of the stable, samples were again taken as before and their germ content carefully determined. The plaster, wall and ceiling of the stable were then whitewashed and the wood work freshly painted, after which other samples were collected from cows milked under these supposedly improved

conditions. As before, the two groups of samples showed little difference in the bacterial content of the milk examined. The average results differed by only 240 germs per unit, with the advantage, if any, in favor of the milk produced before the whitewashing and repainting. These results were so close that no one would be justified in assuming that the data show whitewashing to be an unsanitary practice and calculated to increase the germ content; on the other hand, they offer no support for the common notion that whitewashing of the stable is an important sanitary practice with a strong influence upon the quality of the milk.

The results from this whole series of tests upon the effect of barn conditions suggest that the importance of barn construction has been considerably overestimated and that within rather wide limits the condition of the stable exerts no measurable influence upon the germ content of the milk produced within it.

Clipping cows

Another dairy practice strongly recommended where clean milk is desired is the clipping of the flanks, udders and part of the tails of the cows. Theoretically, this seems a most excellent practice, well adapted to facilitate easy and thorough cleaning of the cow before milking, and the results from the tests of the practice made in our stable were decidedly surprising to the investigators. There are some difficulties in making a test of this kind since it is impossible to alternate the cow on both sides of the experiment in short periods as it requires considerable time for the animal to return to an unclipped condition after she has been clipped. Care was taken, however, to make the test under conditions as nearly alike as possible except for the factor of clipping and it is believed that the results are reliable. In a preliminary experiment, the germ content of the milk from two cows was determined for six days, after which the udders and flanks of the cows were clipped and bacterial counts again made of their milk for a similar period. In this test the general averages appear to show that clipping increased the germ content of the milk, but as the majority of the germs on this side of the test came from one cow on one particular day, too much weight can not be placed on the results. If this particular observation be omitted, the results incline slightly to the other side of the test, that is, in favor of clipping.

In a later test, 22 samples were collected in the regular way from the milk of each of four cows from which bacterial cultures were made and plates counted as in the other tests. The udder, the flank up to the hip joint, and the tail above the brush were then clipped on each of the cows and a few days later, 24 samples from each cow were collected and tested as before. The average germ content of the 88 samples of milk from the unclipped cows was 204 per unit, or, excluding the normal udder content as determined by the strippings, 133 germs per unit. After clipping, the general average was 320 germs per unit from the clipped cows, or excluding the average udder content, 208 germs. These quite extensive measure-

ments give an average of about 75 more germs in the milk of the cows after they had been clipped than before. This would seem to indicate that clipping cows increases, rather than decreases, the probability of germs finding their way into the milk during the milking process. The data certainly do not support the prevailing idea that clipping the udders and flanks of cows is a valuable aid in the production of sanitary milk.

Hand and machine milking of cows

Reasoning on general principles, it is quite logical to assume that the vacuum cleaner would prove as effective when applied to the coats of cows as it is in the household and many departments of business. The use of such an apparatus is quite feasible where the milking machine is installed since a vacuum pump is used in connection with the milker. Such a method of cleaning has been recommended by the American Association of Medical Milk Commissions. In a careful series of tests made in our stable, the germ content of the milk was not reduced by the use of the vacuum cleaner and more time was needed to go over the cows than when currycomb and brush were used. Some difficulty was met with at first in securing what seemed to be an effective vacuum and comparative tests made under these conditions showed a disadvantage, even in the germ content, in the use of the vacuum cleaner. When arrangements were made, by which the vacuum of approximately one-half an atmosphere could be regularly maintained, the differences in germ content between hand cleaning and machine cleaning practically disappeared, but, as stated before, the time required for each animal was greater with the machine than when cleaning by hand. Our results, as a whole, do not seem to justify the purchase of a vacuum cleaner for use in the cow stable.

When do bacteria enter the milk?

In all of these tests the bacterial counts of the milk as drawn were very low and changes in stable conditions seemed to exert no measurable influence upon the number of these organisms present. This raised the question as to what are the important sources of bacteria in milk.

Accordingly, on 17 days the germ content of a pail of milk was followed from the cow through the various operations in preparing it for the consumer. At the Station, the milk is taken to a small milk room, separated from the stable by a single door, poured over an aerating cooler, collected in a second pail and taken in this to the dairy. Here it is passed through a cloth strainer into a third pail in which it is placed in cold water until needed. All these utensils are cleaned with hot water and sal soda and treated for ten to fifteen minutes in a steam box. The cooler was not protected in any special manner during use, though the milk room was kept moderately clean.

Samples were taken which represent the strippings, and the milk in the pail, after leaving the cooler, after arriving at the dairy, and

after straining into the final can. On all of these days except two, the germ content of the milk at every stage was very low, the averages for the entire period showing 57 bacteria per unit in the strippings, 161 for the milk in the pail, 426 after cooling, 443 when it reached the dairy, and 474 after it had been strained. On two days there was apparently some slight contamination of the milk during cooling, but even then it had a germ content which was surprisingly low. These figures were obtained when the dairy operations were all conducted in the ordinary way and show that with reasonably careful handling in a moderately clean stable and clean dairy room, the germ content of the milk can be kept low without special elaborate precautions. The small count throughout in this particular case was due to the fact that the milk was furnished by one cow which had a rather low udder content.

Conclusions

It is common in discussions of the sanitary quality of milk to use, as a general standard, a germ content of 10,000 germs per unit as insuring a milk which is above suspicion of uncleanliness. In obtaining milk which shall be safely below this 10,000 limit, it is the custom to spend much labor in washing the cows and in keeping the interior of the barn scrupulously clean. In all of the tests discussed in this bulletin, the germ content has been very low, seldom exceeding 1,000 germs per unit of which number about one-half are germs normally present in the udders of the cows.

This milk was produced under general conditions which appear to be no better than those surrounding a considerable number of ordinary city dairies, conditions which probably would not be acceptable to any certified milk commission. Notwithstanding these facts the extended study of the product indicates that in bacterial content at least it is of the very highest quality. That milk of this quality is not uniformly produced under such general conditions is illustrated by the fact that a local commercial dairy in which the methods and equipment resemble those at the Experiment Station, except that steam is not available for treating the utensils, quite uniformly turns out a product with a content approximating 1,000,000 germs per unit.

What, then, is the difference between these two dairies? At the Station the stable is kept cleaner, the cows are much cleaner, the milkers are cleaner, and the utensils are thoroughly steamed. Apparently the wide difference in the germ of the product from the two dairies lies in the influence of one or more of these factors. The important fact, which is being gradually recognized through these and similar observations is that the production of a reasonably clean milk with a low germ content will be a far simpler and less expensive undertaking when the factors that really govern its production are actually understood.

DOES WINTER KILL POTATO BLIGHT IN THE SOIL?*

F. H. HALL.

Some plant diseases infect soils.

Rotation of crops is necessary to prevent transmission of several plant diseases. Cabbage should not be planted the second year where the first season's crop has shown much clubroot, and potatoes should not follow potatoes where scab has prevailed, nor where Fusarium wilt and its accompanying tuber rot have been destructive.

The most destructive potato disease in New York State, however, is late blight, with the common rot that follows it; and questions relating to transmission and control of these troubles are exceedingly important. Does this fungus survive the winter in the soil and make a blighted field of one year unsafe to use the next?

Winter probably destroys *Phytophthora*.

Most authorities hold that the fungus causing these two troubles, *Phytophthora infestans*, does not over-winter in the soil; and that there is no more liability to blighting and rotting on a field thus affected the year before than on one free from the disease. Recently two authorities, one in England and one in America, have advanced the opposite view and advise against planting potatoes on soil where blight has been prevalent.

Station tests.

To test the liability to such transmission, the Station Botanist has carried on careful tests in two seasons; and finds no evidence that the fungus can survive the winter in the field, in central New York, at least. In each of the tests, soil from a field of diseased potato plants was thoroughly mixed, in boxes, with broken, rotten tubers and pieces of blighted stems; and the boxes were exposed to the weather during early winter. Later the boxes were brought into the forcing house, a sound potato tuber was planted in each and conditions made as favorable as possible for growth of plants and development of the disease. In spite of warmth, abundant moisture, both in the soil and in the air, and luxuriant, succulent growth of the plants, not a sign of blighting appeared, even when the plants were grown in a special glass chamber and thoroughly wet daily with water drained from some of the soil mixed with diseased material, or were painted with a thin mud made from such soil.

The results, being negative, do not prove that the late-blight fungus cannot remain alive over winter in the soil, but they make such persistence appear highly improbable.

Depend on spraying.

It would seem unnecessary, then, to change the location of the potato crop to avoid this disease; especially as we know that thorough spraying will control both blight and rot and will increase the crop enough, taking one year with another, to make this a highly profitable regular practice in potato growing.

The spraying of late potatoes should never be neglected.

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* Reprint of Popular Edition of Bulletin No. 367; see p. 180 for Bulletin.

A PEAR-DEFORMING PLANT-BUG*

F. H. HALL.

What deforms pears?

Several insects may attack pear fruits in such a way as to deform them. Curculios may pierce them in laying their eggs, casebearers may chew minute holes through the skin, or green fruitworms may destroy considerable areas of both skin and flesh — each species causing an easily recognizable deformity of the fruit. The recent abundance of dropped or deformed pears in many western New York pear orchards, however, is due to a comparatively unknown small insect, the false tarnished plant-bug.

Work of plant-bug.

These little pests, about an eighth of an inch long in their most destructive stages, pierce the tender pear stems and the young pears before they are a half inch in diameter, suck out the juices, and cause the fruits to drop if the punctures are early or numerous, or deform the injured pears if they still remain on the trees. The injury is a characteristic one — quite different from those produced by other insects. From the minute orifices left by the punctures drops of sap first exude and may hang for some time, but when these disappear the work of the insects shows as small blackish spots or points. As the pears grow, the outer layer of the skin about these spots becomes ruptured, and a light-yellow, mealy-appearing growth of the inner layers of the skin protrudes, making a more or less triangular, granular spot; or when two or more spots run together a patch or crack lined and bordered with corky tissue. The yellowish, protruding growth at first makes a marked contrast with the smooth green skin of the little pear; and later the cessation of growth at these points causes depressions and marked general deformity of the fruit. In the flesh beneath, also, hard, gritty granulations are produced, through which it is difficult to cut with a knife.

The insect and its history.

The insect causing this trouble is a species very closely allied to the common tarnished plant-bug, so abundant during hot, dry summers on weeds and succulent plants about the farm and garden, where it often does considerable harm by checking and dwarfing new growth and tender buds.

* Reprint of Popular Edition of Bulletin No. 368; see p. 308 for Bulletin.

Injury to pears, similar to, if not identical with, that common during the past half dozen years in orchards near Lockport, Fairport, Albion, and elsewhere, has been noticed occasionally since 1884, and sometimes ascribed to other insects, sometimes to the common tarnished plant-bug, and, in a few instances, to this less known species, the false tarnished plant-bug, *Lygus invitus*. Studies by the Station entomologists, beginning in 1908, seem to prove quite conclusively that the false tarnished plant-bug is the guilty insect, since it is usually the most common species present in orchards where injury of this kind is severe; the tiny insects have been watched in the open at their pear-puncturing work; and in observation cages where they were the only insects present, the fruits have developed the characteristic injury.

Study of the little pests has been very difficult, however, and their whole life history has not yet been traced. They are very shy and very active in the orchards, disappearing from sight at the first alarm, and in the breeding cages they are very sensitive, living only a comparatively short time, though provided with an ample supply of their food plants.

The original host of this species is supposed to be the wild grape since the insects are frequently found on these plants and have been reported as feeding on the blossom clusters and young fruits of cultivated grapes, where they sometimes do considerable harm. They are also said to feed on peach and have been found to attack the young fruits in the observation cages, though not found by Station investigators on peaches in the open, in the Station orchards or elsewhere.

They appear upon the pear, as tiny nymphs of the first stage, at blossoming time, and during the first two of their five immature forms they feed mostly on the tender, unfolding leaves. They are then very active, yellowish or light green, " spidery " little creatures, moving repeatedly from one spot to another and puncturing the tissues of leaves at many places. The injured leaves later become quite ragged through the dropping out of areas about the punctures. In the last three stages the nymphs feed more largely on the young pears and their stems and move about somewhat less freely. A favorite place seems to be in the sheltered areas within the pear cluster while the little fruits are still upright and close together. In their later stages the nymphs become somewhat darker and develop " wing-pads," so that when they change to adults they are yellowish brown or dark brown in color and have two pairs of wings, the outer pair thickened at the base to serve as wing covers.

It takes a month or more for the insects to pass through the five " nymphal instars " or immature stages, so they are found on the pear trees in one of these forms through May and the first week or ten days in June, while the adults remain about a month longer in the orchards but finally disappear during late July.

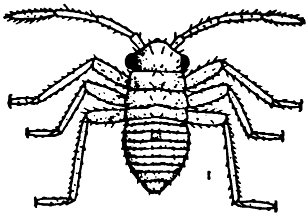

FIG. 2.—FIRST STAGE NYMPH.

FIG. 1.—EGG.

FIG. 3.—SECOND STAGE NYMPH.

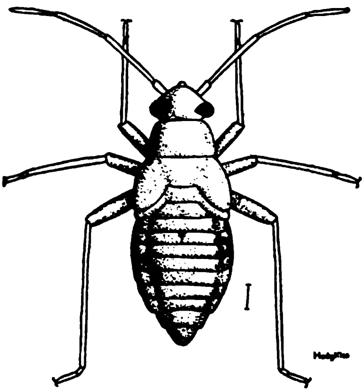

FIG. 5.—FOURTH STAGE NYMPH.

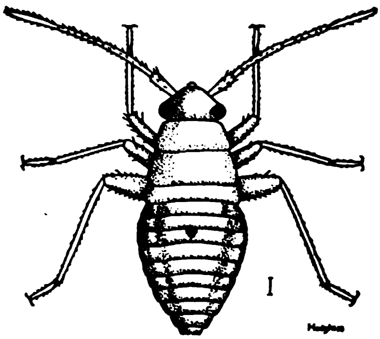

FIG. 4.—THIRD STAGE NYMPH.

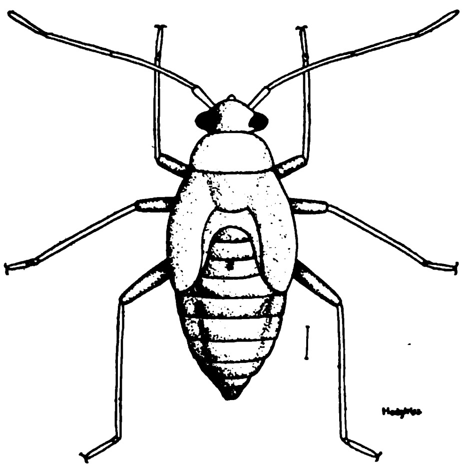

FIG. 6.—FIFTH STAGE NYMPH.

PLATE XXIX.—EGG AND NYMPHAL STAGES OF FALSE TARNISHED PLANT-BUG.

Damage and its prevention. The false tarnished plant-bug seems to be widely distributed in western New York but it is only in scattered orchards that it does much harm. Where thoroughly established, though, it is a serious pest. In one large pear plantation near Lockport in 1908 it was estimated that only one pear in four escaped attack, and that 75 per ct. of those attacked would prove unmarketable at maturity. The worst injured young pears were picked off as soon as possible after the attack of the insects had ended, in which thinning it was estimated that the harvest was reduced at least 500 bushels. Several other orchards suffered similarly, though less severely. All the leading commercial varieties of pears are attacked; some sorts that have been injured severely in the same or different orchards being Bartlett, Angouleme, Clairgeau, Seckel and Kieffer.

It is believed that in some cases the attack has come from insects feeding and breeding in bushy woodlands adjoining the orchards, or from weedy and shrubby roadsides, ditches and fences; but in at least one case where the injury has been very severe the orchard and its surroundings are very well kept and free from rubbish of any kind. It is probable that when the insect becomes well established in an orchard it can maintain itself there, no matter how clean the cultivation; but when the invasion is only slight, cleaning up waste land, weedy spots, growths of wild grape and sumac along borders or ditches and the maintenance of clean culture will aid in controlling the pest and may get rid of it.

The main protective resource, however, must be spraying. The grower who has any fear of attack by this insect should examine his trees carefully, commencing with the dropping of the petals, and if the young nymphs are found should spray immediately. Ordinarily, one application, made just after the blossoming period, should control the bugs efficiently. Treatment should not be delayed until injuries commence to show on the young fruits. In the Station's spraying tests, tobacco extract (40 per ct. nicotine (Black Leaf 40), using three-fourths of a pint of the extract to one hundred gallons of water to which are added three pounds of soap) has given the most satisfactory results of the various mixtures which have been tried. In applying the spray the trees should be drenched, special pains being taken to wet both surfaces of the leaves. Some growers have combined the nicotine extract with dilute lime-sulphur containing arsenate of lead as applied for codling moth with equally satisfactory results on both insects and foliage and by this means avoided the necessity of an extra spraying. But as there is danger of burning pear foliage by drenching the trees with lime-sulphur, we would advise, as a general recommendation, a special treatment with nicotine and soap to combat this pest.

SOME FAULTS IN FORMALDEHYDE DISINFECTION OF POTATOES.*

F. H. HALL.

Why formaldehyde disinfection is popular.

Formaldehyde gas and its solutions in water are convenient and effective disinfectants for use under many conditions. As they require no fire in application they are safer to use than sulphur, and they do not corrode or tarnish metal fixtures or apparatus as do sulphur fumes; they are comparatively inodorous, therefore more pleasant to apply and quicker to disappear from notice than carbolic acid and similar compounds; and they are not poisonous, consequently far less dangerous to keep and use in homes and on farms than corrosive sublimate. For these reasons, the formaldehyde preparations have become very popular in human and animal sanitation; and they are used with success, also, in preventing some plant diseases, such as some of the grain smuts.

Use in potato tuber treatment.

In 1897, less than a decade after the discovery of the germicidal value of formaldehyde, its use, in liquid form, was recommended for the prevention of potato scab; and this method of treatment for insuring clean seed has become standard and is widely used. The non-poisonous nature of the liquid recommends it to thousands of growers in place of the dangerous mercury compound, corrosive sublimate.

Soon experimenters began using formaldehyde gas, generated by heating the liquid, for treating potatoes, but in 1905 this was superseded by a new method. By combining the liquid formalin with crystals of potassium permanganate, the formaldehyde gas is quickly set free without the use of external heat. This new method gave marked results in treatment for scab, apparently without injury to the tubers. If equally safe and effective this gas treatment offers

* Reprint of Popular Edition of Bulletins Nos. 369 and 370; see pp. 185 and 217 for Bulletins.

decided practical advantages over the treatment with liquid, because of its greater convenience and its lessening of the task of handling the potatoes. It soon promised to supersede these older methods.

Gas injures tubers in Station work.

In the spring of 1912 the Station Botanist and his associate had occasion to disinfect nearly 90 bushels of potatoes stored in bushel crates in a large cellar under the Station tool-house. As no smaller room was convenient and as the labor of moving the crates would have been considerable, it was decided to use the entire cellar as a disinfection room. This involved much larger amounts of chemicals than needed, since the entire space must be filled with the gas although the tubers occupied only a small part of it.

In the fumigation the method used was that recommended by Prof. Morse of Maine, one of the adapters of the use of permanganate and formalin for potato treatment. To the great surprise of the investigators, they found that many of the tubers were seriously injured by the treatment, particularly those most exposed in the top crates. In many cases the eyes of the potatoes were surrounded by circular, sunken areas of brown, dead tissue, while on these tubers and on many others, the skin was marked, as shown on the title page illustration, with numerous sunken brown spots, of various shapes and ranging in size from mere specks to areas a half-inch across. Many of these spots were circular ones, each surrounding a lenticel, or minute pore-like opening through the skin of the tuber. The potatoes in the forty crates on top were sorted, and one-fourth of them rejected as too seriously injured to be used for seed.

Search for cause of injury.

This unfortunate result, so contrary to experience elsewhere, made advisable a very careful study of the conditions to ascertain the reason for the damage. During the remainder of the spring of 1912 and in the winter and spring of 1913 more than 80 lots of potatoes were fumigated, varying the conditions in many directions in order to cover any change in the factors that might possibly have been concerned in the trouble.

Effect of temperature changes.

Variations in the temperature of the air in the disinfection chamber were shown to have very slight effect on the amount of injury, even when the range was as great as 45° F. At temperatures below 50° the gas showed a slight tendency to change to paraformaldehyde, in which condition it becomes a whitish, powdery precipitate and is probably useless for disinfection. In some of the tests at low temperatures this " paraform " appeared as a very faint deposit of whitish dust on sheets of black paper in the disinfection chamber; but the reduction of the action of the gas was very slight; since the injury to tubers at 42° where this change was noticed was no less than at 87° where no such change would take place.

A low temperature of the chemicals used, however, may have quite an effect upon the efficiency of the fumigation, since chemical combination is much less active at low temperatures. In one test where the formalin and potassium permanganate crystals were cooled to 34° F. before uniting them, the reaction was a failure; but at 51° the final combination was as complete as at 71°, though the release of the gas was much slower.

Humidity. A high moisture content of the air in a disinfection chamber is held to be helpful in securing perfect results; but the humidity will probably be high enough under conditions usual in fumigating potatoes; for this work will ordinarily be done in a cellar or other room without artificial heat to dry out the air. In none of the Station tests was the humidity, when at its maximum for the test, less than 73 per ct. In most of the tests it reached a maximum of 90 per ct. and in one the air was apparently more than saturated, the recording instrument showing 104 per ct. Under these conditions, with no test in air really low in humidity, it is impossible to say how much increase in moisture content increases the efficiency of the gas; but apparently slightly more injury resulted when the humidity was high.

Tubers wet when placed in the disinfection chamber showed considerably more injury than those in the same test that were thoroughly dry. This point is of some practical importance; for potatoes brought from a cool cellar into warm, moist air quickly become wet through condensation; and if other conditions were favorable might be injured by fumigation because of the moisture.

Sprouted potatoes. Under almost all conditions, tubers that had just begun to sprout, that is, with sprouts an eighth of an inch long or less, were much more seriously injured than those with dormant eyes, or even those with longer sprouts. Such sprouted tubers are undoubtedly really injured for seed; but it is believed that potatoes with dormant eyes, and that show no eye injury within three days after treatment, may still be used for seed even though somewhat spotted about the lenticels. This lenticel spotting is usually least severe at the eye end of the potato, as shown very plainly on the dumb-bell shaped tuber illustrated on the title page.

Some unimportant factors. In tests of a dozen or more varieties, slight differences in susceptibility were shown; but Sir Walter Raleigh, the kind so severely injured in the original fumigation, was found no more liable to the spotting than several other varieties. In this first fumigation the tubers on the tops of the crates were most injured; but in the other experiments no logical explanation for this fact could be discovered. It clearly shows a stronger action of the gas on these outer tubers, however, and would seem to indicate that, to secure

uniform efficiency of treatment, it would be well to expose the potatoes in shallow trays rather than in crates or boxes.

Potatoes placed directly over the fumigating vessel are liable to severe injury from the rising, undiluted gas; and they should never be so placed. This fact was known before the injurious fumigation was made; so that no crates were placed above the mixing pans, nor were any nearer than 2½ feet. This injury to tubers directly over the generator was considered so well established that only one test involved such placing of the tubers. In this case two potatoes placed in a wire basket 6 or 7 inches above the chemicals were much more seriously injured than others on the bottom of the chamber. Other tubers near the top of the chamber but not directly over the generator were no more injured than those on the floor; and those placed very close to the generator, on the bottom of the chamber, were as free from injury as those farther away. Any injury to the skin of the potato, like a pin prick, was sure to result in an injured spot; but the tests did not support the view that injury can result only where the skin is broken. If this theory be true, there could have been no tubers with unbroken skins in some of the tests; for every potato showed injury.

Small quantity of potatoes the true cause. The factors hitherto mentioned could not, all together, have caused the injury that followed the first fumigation, though some of them may have had a tendency to increase or to diminish it. As the subsequent tests plainly showed, it was the use of so large a cellar for the disinfection of a comparatively small quantity of potatoes that led to the trouble.

In each test in which 12 lbs. or more of potatoes to each cubic foot of space in the disinfection chamber were exposed to the action of gas at the strength commonly employed, no injury of any kind resulted; when from 5 to 10 lbs. of tubers to each cubic foot were fumigated, lenticel spotting appeared, but little or no eye injury; but when the quantity of potatoes per cubic foot was reduced to 5 lbs. or less the injury was marked about both lenticels and eyes.

In the original fumigation, the 87 bushels of potatoes were treated in a cellar containing 3,500 cubic feet, making only about 1½ lbs. of potatoes to a cubic foot, an amount far below the minimum found necessary, in the tests, to insure safety.

Rôle of adsorption. At first thought this explanation appears a paradox; for it would seem that 12 lbs. of potatoes per cubic foot would occupy much more of the room than two pounds, would crowd the gas into a smaller volume, concentrate it and cause more rather than less injury. This would be true were it not for a peculiar ability which many, if not all solid bodies possess, to collect upon their surfaces large amounts of certain gases. For example, boxwood charcoal will "adsorb" ninety times its own volume of ammonia gas, fifty volumes of hydrogen sulphide

or nine volumes of oxygen. Potatoes have this power of adsorbing considerable quantities of formaldehyde gas upon their surfaces, until, when it reaches a certain degree of concentration, it enters into a chemical combination with the tissues around a lenticel, an eye or a wounded place and produces death of these tissues. If the number of potatoes be small the concentration readily continues until this danger point is reached and passed; but if the quantity be large and the amount of surface extensive the adsorption ceases, through lack of available gas to draw upon, before this point of dangerous concentration is reached. This power of the potatoes to adsorb formaldehyde gas and thus to reduce the amount of the free gas in the air of the disinfection chamber was quite evident by direct observation when attention was called to it. On opening the chamber after fumigating only a few tubers, the gas was so strong that it was impossible to thrust one's head within because of choking and smarting the eyes, but when the quantity of tubers was large and the same amount of gas was generated, so little of it remained free in the air of the chamber that one could breathe it without great discomfort. In the cellar fumigation, the gas was still so strong in the back part of the room 16 hours after the door had been opened that additional ventilation had to be provided before handling the potatoes.

By other experiments it was proven that it was adsorption, not absorption or chemical union of the gas with the potatoes, that withdrew it from the air; for when 5½ bushels of cobblestones were substituted for the same bulk of potatoes in the chamber they also adsorbed the gas so that its disappearance from the air was equally evident to the senses and the injury to check tubers was almost equally slight.

That injury similar to that in the Station cellar had not been noted in other experimental or commercial fumigating is probably due to the use of small disinfection rooms quite well filled with potatoes in order to economize in the purchase of materials. In the Station work economy seemed to lie in the purchase of more chemicals rather than in fitting up a smaller room and moving the potatoes to it. The experience, though immediately disastrous, may be valuable if it serves as a warning to others not to use large rooms for such disinfection unless the quantity of potatoes is also large.

Gas treatment not certain to destroy Rhizoctonia.

This extensive series of fumigation tests gave an excellent opportunity to learn the effectiveness of the gas treatment under varied conditions; and tubers known to be carriers of disease were included in many of the tests. It would have been fortunate if the disease to be studied could have been scab, the one for which seed treatment is most commonly used. Unluckily, however, the fungus producing this disease does not grow readily

in the laboratory, and it was only by laboratory study that the efficiency of the treatments could be determined in such an investigation, where the number of tubers used in each test was small and where the tests were so numerous. To have depended on field trials in this case would have been out of the question.

Accordingly another fungus was selected, Rhizoctonia, which produces several different potato troubles and is believed to be a common cause of "skips" in the stand of plants. The means by which this fungus maintains itself over winter are somewhat different from those of most fungi. It does not penetrate the tuber with its mycelium and remain alive therein as does late blight, nor mar the potato with scars and deformities as does scab, nor does it form spores that cling to the potato as do those of some of the smut fungi to grain. But as the potato matures the Rhizoctonia forms on the surface of the tuber, on which it grows in the soil, small rounded collections of tightly-packed fungus tissue. These little bodies, sclerotia, are very resistant and serve almost as well as spores or seeds to maintain the life of the fungus. They appear on the potato as small, brownish bodies, much like tiny lumps of dirt, but they cannot be dislodged by washing as can dirt. They are frequently so numerous as to make the potato rough and unsightly, and may lessen its market value.

Like other fungus tissues, these sclerotia are destroyed by fungicides, but in them the microscopic cells are so tightly packed together that some of them in the interior may not be reached by the chemical and may remain alive even though the outer portion be destroyed. When placed under proper laboratory conditions they easily start into growth unless completely destroyed; so they make a very good means for studying the efficiency of any treatment. Accordingly tubers showing several of these sclerotia, which are very easily recognized, were used in many of these tests and, for purposes of comparison, others were soaked in formalin solutions and in corrosive sublimate (mercury bichloride) solutions, using different strengths of each.

In many cases when exposed to the formaldehyde gas at standard strength, for 24 hours, the Rhizoctonia sclerotia remained alive on the tubers so that the fungus developed well in the laboratory cultures. In many cases, also, other fungi appeared in these cultures, showing that the gas treatment was not thoroughly reliable. In a general way it may be said that the efficiency diminished as the quantity of tubers treated increased, but there were some notable exceptions to this. In a few cases in which the number of potatoes was so small that the tubers themselves were injured by the gas, quite a percentage of the sclerotia came through alive. Bacteria in large numbers also developed after this gas treatment. As moistened tubers showed more injury from the gas than dry ones, so

the Rhizoctonia sclerotia were much more completely destroyed on tubers that had been put into the fumigator when wet.

Liquid disinfection. Soaking the tubers in formaldehyde solution was no more effective in destroying the Rhizoctonia sclerotia than was fumigation unless the time of immersion was long or strength of solution increased above that usually recommended. In eight tests with a 1-to-240 solution and a two-hour immersion almost one-fourth of the sclerotia grew in the cultures, but when the time was increased to 24 hours all were destroyed, as they were also when the strength of solution was made 1-to-20 and the time was 2 hours.

In corrosive sublimate solution, however, even as low strength as 1-to-2000, the sclerotia were destroyed by less than a 2-hour treatment.

The scab-fungus spores and mycelium are probably less resistant to fungicides than these Rhizoctonia sclerotia, but this series of tests casts considerable doubt upon the efficiency of the treatment with formaldehyde gas for scab; while it surely cannot be relied on to prevent the transmission of Rhizoctonia.

General conclusions. It seems best, therefore, to advise potato growers who wish to disinfect the tubers they use for seed, to use the gas treatment only in cases where it is impracticable to use either the liquid formaldehyde solution or corrosive sublimate. The safety and efficiency of both the liquid treatments for scab have been thoroughly established, while the evidence just given proves the gas treatment unreliable for controlling Rhizoctonia and casts considerable doubt on its effectiveness against scab. When it is desired to treat potatoes for both Rhizoctonia and scab the corrosive sublimate solution should be used; but in treating for scab alone the formaldehyde solution is effective, while the corrosive sublimate solution, though effective, is in many ways less desirable to use.

Directions for using treatments. The method to be used in applying any one of these treatments is summarized in the following paragraphs, which should be carefully read before beginning the work.

Formaldehyde gas.— Use a thoroughly tight, unheated room. Place the seed tubers in shallow, slatted crates, not over eight inches deep, and so arranged that the gas may circulate freely on all sides of the potatoes. For each 1,000 cubic feet of space in the disinfection room use three pints of formaldehyde (40 per ct. solution) and 23 ounces of potassium permanganate (slender, needle-shaped crystals). Spread the potassium permanganate over the bottom of a large pan or pail having a capacity equal to about one quart for each ounce of permanganate. Pour on the formaldehyde, close the door at once and keep it closed for 24 hours. It is important that the disinfection room contain approximately 10 lbs.

of potatoes per cubic foot or 167 bushels per 1,000 cubic feet. With smaller quantities the tubers are liable to be injured by the treatment; while with larger quantities the treatment may not be effective. If necessary to treat smaller quantities than ten pounds per cubic foot it is suggested that a smaller room be fitted up for a fumigator if possible, or that the quantity of chemicals be reduced proportionately. No tubers should be placed directly above the generator. If possible, the treatment should be made before the tubers have begun to sprout as sprouted tubers are more liable to injury. The temperature of the chemicals at time of mixing should be above 50° Fahr.

Formaldehyde solution.— Mix one pint of 40-per-ct. formaldehyde solution with 30 gallons of water. Soak the uncut tubers in this solution for two hours. The same solution may be used repeatedly. Treated tubers not required for planting may be used for food or fed to animals with perfect safety.

Corrosive sublimate solution.— Prepare a solution containing 2 ounces of corrosive sublimate in 15 gallons of water. This is best done by first dissolving the corrosive sublimate in a small quantity of hot water and afterward diluting to the required amount. Soak the uncut tubers in this solution 1½ hours. Recent investigations by Güssow and Shutt in Canada indicate that the strength of corrosive sublimate solution decreases so rapidly with use that it is necessary to reject it after using three or four times. As the solution corrodes metals it should be used only in wooden or stone vessels. These should be kept away from animals until very thoroughly cleansed from the solution. It is very poisonous. All treated tubers should be either planted or buried.

With any of the scab treatments care should be taken that treated tubers are not reinfected by coming in contact with bags or crates which have held scabby potatoes.

PERIODICALS RECEIVED BY THE STATION.

Acclimitation	Complimentary
Agricultural Epitomist	Complimentary
Agricultural Gazette of New South Wales	Complimentary
Agricultural Journal, China	Complimentary
Agricultural Journal of the Union of South Africa	Complimentary
Agricultural News	Complimentary
Agricultural Students' Gazette	Complimentary
Allegan Gazette	Complimentary
American Agriculturist	Subscription
American Breeders' Magazine	Subscription
American Chemical Journal	Subscription
American Chemical Society, Journal	Subscription
American Cultivator	Complimentary
American Entomological Society, Transactions	Subscription
American Fertilizer	Subscription
American Florist	Subscription
American Grocer	Complimentary
American Hay, Flour and Feed Journal	Complimentary
American Journal of Physiology	Subscription
American Miller	Complimentary
American Naturalist	Subscription
American Philosophical Society, Proceedings	Complimentary
American Poultry Advocate	Complimentary
American Stock Keeper	Complimentary
Analyst	Subscription
Annales de l'Institut Pasteur	Subscription
Annales de la Societe Entomologique de Belgique	Complimentary
Annales Mycologici	Subscription
Annals and Magazine of Natural History	Subscription
Annals of Botany	Subscription
Archiv der Gesammte Physiologie (Pflueger)	Subscription
Archiv fuer Hygiene	Subscription
Association belge des Chimistes, Bulletin	Complimentary
Berichte der deutschen botanischen Gessellschaft	Subscription
Berichte der deutschen chemischen Gessellschaft	Subscription
Better Fruit	Complimentary
Bibliographia Zoologica	Subscription
Biedermann's Zentralblatt fuer Agrikultur Chemie	Subscription
Biochemical Bulletin	Complimentary
Biochemische Zeitschrift	Subscription
Biological Bulletin	Subscription
Biologisches Centralblatt	Subscription

Blooded Stock	Complimentary
Boletim dc Agricultura	Complimentary
Boletim do Instituto Agronomico	Complimentary
Boletin de la Sociedad Nacional de Agricultura	Complimentary
Boston Society of Natural History, Proceedings	Complimentary
Botanical Gazette	Subscription
Bulletin de l'Institut Pasteur	Subscription
Bulletin fuer angewandte Botanik	Subscription
Caledonia Era	Complimentary
California Academy of Sciences, Proceedings	Complimentary
California Cultivator	Complimentary
California Farmer	Complimentary
California Fruit Grower	Subscription
California University Publications—Agricultural Sciences, Botany and Zoology	Complimentary
Canadian Entomologist	Subscription
Canadian Horticulturist	Complimentary
Carlson's Rural Review	Complimentary
Centralblatt fuer Bakteriologie, etc	Subscription
Chemical Abstracts	Subscription
Chemical Society, Journal	Subscription
Chemisches Centralblatt	Subscription
Chicago Daily Farmers' and Drovers' Journal	Complimentary
Chicago Dairy Produce	Complimentary
Cincinnati Weekly Enquirer	Complimentary
Cold Storage and Ice Trades Review	Complimentary
Colman's Rural World	Complimentary
Colonial Dairy Produce Report	Complimentary
Columbus Horticultural Society Journal	Complimentary
Commercial Poultry	Complimentary
Country Gentleman	Subscription
Country Life in America	Subscription
Country World	Complimentary
Creamery and Milk Plant Monthly	Complimentary
Criador Paulista	Complimentary
Dairy and Produce Review	Complimentary
Denni Hlasatel	Complimentary
Denver Field and Farm	Complimentary
Deutsche entomologische Zeitschrift	Complimentary
Deutschlands Obstsorten	Subscription
Dry Farming	Subscription
Elgin Dairy Report	Complimentary
Elisha Mitchell Scientific Society, Journal	Complimentary
Entomological News	Subscription
Entomological Society of America, Annals	Subscription
Entomological Society of Washington, Proceedings	Subscription

Entomologist	Subscription
Entomologists' Record	Subscription
Ernahrung der Pflanze	Complimentary
Farm and Fireside	Complimentary
Farm and Live Stock Journal	Complimentary
Farm and Orchard	Complimentary
Farm and Stock	Complimentary
Farm Journal	Complimentary
Farm Life	Complimentary
Farm News	Complimentary
Farm Poultry	Complimentary
Farm, Stock and Home	Complimentary
Farm Stock Success	Complimentary
Farmers' Advocate	Complimentary
Farmers' Digest	Complimentary
Farmers' Guide	Complimentary
Farmers' Voice	Complimentary
Feather	Subscription
Feathered World	Subscription
Field, The, Illustrated	Complimentary
Florists' Exchange	Subscription
Flour and Feed	Complimentary
Fruit Grower	Complimentary
Furrow	Complimentary
Garden	Subscription
Gardeners' Chronicle	Subscription
Gardening	Subscription
Gartenwelt	Subscription
Gas and Oil Power	Complimentary
Gentlewoman	Complimentary
Gleanings in Bee Culture	Complimentary
Grape Belt, The	Complimentary
Green's Fruit Grower	Complimentary
Hartwick Seminary Monthly	Complimentary
Hawaiian Forester and Agriculturist	Complimentary
Hedwigia	Subscription
Herd Register	Complimentary
Hoard's Dairyman	Complimentary
Holstein-Friesian Register	Complimentary
Holstein-Friesian World	Complimentary
Homestead	Complimentary
Hygienische Rundschau	Subscription
Indiana Farmer	Complimentary
Insect World (Japanese)	Complimentary
Internationale Mitteilungen fuer Bodenkunde	Subscription
Jahresbericht der Agrikultur-Chemie	Subscription

Jahresbericht Garungs-Organismen	Subscription
Jahresbericht der Nahrungs- und Genussmittel	Subscription
Jahresbericht Pflanzenkrankheiten	Subscription
Jahresbericht der Tier-Chemie	Subscription
Jahresheft Schlesische Insektenkunde	Complimentary
Jersey Bulletin	Complimentary
Journal de Botanique	Subscription
Journal fuer Landwirtschaft	Subscription
Journal of Agricultural Research	Complimentary
Journal of Agricultural Science	Subscription
Journal of Agriculture, Victoria	Complimentary
Journal of Biological Chemistry	Subscription
Journal of Board of Agriculture (English)	Complimentary
Journal of the College of Agriculture, Tokyo	Complimentary
Journal of the Dept. of Agriculture of South Australia	Complimentary
Journal of the Dept. of Agriculture of Victoria	Complimentary
Journal of the New Zealand Department of Agriculture	Complimentary
Journal of Economic Biology	Subscription
Journal of Experimental Medicine	Subscription
Journal of Experimental Zoology	Subscription
Journal of Genetics	Subscription
Journal of Home Economics	Subscription
Journal of Industrial and Engineering Chemistry	Subscription
Journal of Physiology	Subscription
Just's Botanischer Jahresbericht	Subscription
Kimball's Dairy Farmer	Complimentary
Königleichen Bayerische Akademic der Wissenschaften: Sitzungsberichte der Math.— Phys. Classe	Subscription
Land, The	Complimentary
Lanswirtschaft-Historische Blätter	Complimentary
Landwirtschaftliche Jahrbucher	Subscription
Landwirtschaftlicher Jahrbuch der Schweiz	Subscription
Landwirtschaftlichen Versuchs-Stationen	Subscription
Lewiston Orchards Life	Complimentary
Live Stock and Dairy Journal	Complimentary
Live Stock Report	Complimentary
Maandblad der Nederlandsche Pomologische Veeriniging	Complimentary
Market Growers' Journal	Complimentary
Memoirs of the Department of Agriculture in India	Complimentary
Metropolitan and Rural Home	Complimentary
Michigan Farmer	Complimentary
Milchwirtschaftliches Zentralblatt	Subscription
Minnesota and Dakota Farmer	Complimentary
Mirror and Farmer	Complimentary
Monthly Bulletin, International Institute of Agriculture	Complimentary

Monthly Bulletin of the N. Y. State Department of Health..	Complimentary
Monthly Weather Review	Complimentary
Mycologia	Subscription
National Nurseryman	Complimentary
National Farmer and Stock Grower	Complimentary
National Stockman and Farmer	Complimentary
Naturaliste Canadienne	Complimentary
Nebraska Farmer	Complimentary
New Education	Complimentary
New England Farmer	Complimentary
New York Academy of Science, Annals and Transactions	Subscription
New York Botanical Garden, Bulletin	Complimentary
New York Entomological Society, Journal	Subscription
New York Farmer	Complimentary
New York Fruit and Produce News	Complimentary
New Zealand Dairyman	Complimentary
North American Horticulturist	Complimentary
Northwest Pacific Farmer	Complimentary
Nut Grower	Complimentary
Ohio Farmer	Complimentary
Ohio Naturalist	Subscription
Oklahoma Farm Journal	Complimentary
Outdoor World and Recreation	Complimentary
Pacific Coast Fanciers' Monthly	Subscription
Pacific Northwest	Complimentary
Pacific Fruit World	Complimentary
Parasitology	Subscription
Pennsylvania Farmer	Complimentary
Photo-Miniature	Subscription
Phytopathology	Subscription
Parasitology	Subscription
Popular Agriculturist	Complimentary
Poultry	Complimentary
Poultry Herald	Subscription
Poultry Husbandry	Complimentary
Poultry Item	Complimentary
Poultry Industry	Complimentary
Poultry Keeper	Complimentary
Poultry Monthly	Complimentary
Power and Engineer	Subscription
Practical Dairyman	Complimentary
Practical Farmer	Complimentary
Practical Fruit Grower	Complimentary
Praktische Blaetter	Subscription
Profitable Farming	Complimentary
Progressive Farmer	Complimentary

Psyche	Subscription
Public Service Monthly (Saskatchewan)	Complimentary
Quarterly Journal	Complimentary
Rabenhorst's Kryptogamen-Flora	Subscription
Reliable Poultry Journal	Subscription
Republic	Complimentary
Review of Applied Entomology	Subscription
Revista Industrial y Agricola de Tucuman	Complimentary
Revue Generale de Botanique	Subscription
Revue Generale du Lait	Subscription
Revue Horticole	Subscription
Riqueza Agricola	Complimentary
Rochester Academy of Science, Proceedings	Complimentary
Royal Agricultural Society, Journal	Subscription
Royal Botanic Gardens, Edinburgh, Notes	Complimentary
Royal Horticultural Society, Journal	Complimentary
Rural Life	Complimentary
Rural New Yorker	Subscription
Saint Louis Academy of Science, Transactions	Complimentary
Salt Lake Herald	Complimentary
Sanitary Inspector	Complimentary
Science	Subscription
Scientific American	Subscription
Scientific Roll, Bacteria	Subscription
Skaneateles Democrat	Complimentary
Smallholder, The	Complimentary
Societe Entomologique Belgique, Annales	Complimentary
Societe Entomologique de France, Bulletin	Complimentary
Societe Mycologique de France, Bulletin	Subscription
Southern Planter	Complimentary
Southern Tobacconist and Modern Farmer	Complimentary
Southern Farm Magazine	Complimentary
Southwest Trail	Complimentary
Southwestern Farmer and American Horticulturist	Complimentary
Southwestern Farmer and Breeder	Complimentary
Southwestern Stockman — Farmer and Feeder	Complimentary
Standard and Poultry World	Complimentary
Station, Farm and Dairy	Complimentary
Stazione Sperimentale Agrarie Italiane	Complimentary
Student Farmer, The	Complimentary
Successful Farming	Complimentary
Texas Stockman and Farmer	Complimentary
Torrey Botanical Club, Bulletins and Memoirs	Subscription
Transvaal Agricultural Journal	Complimentary
Trucker and Farmer	Complimentary
Utica Semi-Weekly Press	Complimentary

Valley Farmer	Complimentary
Wallace's Farmer	Complimentary
Weekly Enquirer (Cincinnati)	Complimentary
West Indian Bulletin	Complimentary
West Virginia Farm Review	Complimentary
Western Fruit-Grower	Complimentary
Western Plowman	Complimentary
Wilson Bulletin	Complimentary
Wisconsin Natural History Society, Bulletin	Complimentary
Zeitschrift fuer Analytische Chemie	Subscription
Zeitschrift fuer Biologie	Subscription
Zeitschrift fuer Botanik	Subscription
Zeitschrift fuer Entomologie	Complimentary
Zeitschrift fuer Hygiene und Infektionskrankheiten	Subscription
Zeitschrift fuer Induktive Abstammungs- und Vererbungslehre	Subscription
Zeitschrift fuer Pflanzenkrankheiten	Subscription
Zeitschrift fuer Physiologische Chemie	Subscription
Zeitschrift fuer Wissenschaftliche Insektenbiologie	Subscription
Zentralblatt fuer Biochemie und Biophysik	Subscription
Zoological Record	Subscription
Zoologischer Anzeiger	Subscription

METEOROLOGICAL RECORDS FOR 1913.

METEOROLOGICAL RECORDS FOR 1913.

READING OF MAXIMUM AND MINIMUM THERMOMETERS FOR 1913.

DATE.	January.		February.		March.		April.		May.		June.	
	5 P. M. Max.	5 P. M. Min.	5 P. M. Max.	5 P. M. Min.	5 P. M. Max.	5 P. M. Min.	5 P. M. Max.	5 P. M. Min.	5 P. M. Max.	5 P. M. Min.	5 P. M. Max.	5 P. M. Min.
1	43.	31.	37.	14.	39.	23.	47.	30.	76.	37.	81.	49.
2	48.	28.	24.	10.	33.	16.	51.	31.	84.	60.	71.	48.
3	43.	33.	32.	18.	32.	8.	58.	36.	88.	51.	81.	46.
4	34.	26.	25.	19.	32.	20.	71.	49.	91.	53.	80.	50.
5	34.	19.	22.	7.	35.	14.	67.	36.	88.	56.	74.	47.
6	45.	28.	15.	4.	33.	11.	39.	28.	82.	55.	86.	56.
7	43.	26.	21.	6.	12.	1.	42.	29.	65.	42.	84.	56.
8	34.	18.	26.	14.	32.	1.	45.	27.	64.	35.	60.	39.
9	29.	10.	24.	10.	54.	25.	45.	30.	62.	44.	60.	37.
10	36.	21.	22.	—10.	48.	29.	48.	27.	53.	33.	71.	39.
11	43.	33.	37.	22.	43.	31.	53.	37.	53.	30.	78.	48.
12	45.	19.	31.	7.	52.	26.	55.	42.	65.	38.	81.	54.
13	27.	8.	22.	4.	56.	36.	51.	38.	66.	46.	84.	51
14	33.	11.	37.	12.	69.	44.	53.	39.	61.	44.	82.	64.
15	42.	29.	45.	28.	69.	37.	65.	35.	59.	34.	90.	53.
16	44.	37.	41.	16.	45.	25.	61.	42.	67.	50.	91.	67.
17	57.	40.	41.	15.	28.	18.	58.	34.	74.	49.	88.	62.
18	53.	40.	29.	13.	57.	16.	75.	35.	72.	51.	76.	45.
19	46.	28.	48.	16.	64.	34.	72.	31.	61	40.	72.	46.
20	50.	30.	65.	38.	68.	40.	42.	24.	67.	38.	74.	62.
21	52.	23.	52.	28.	68.	37.	57.	29.	65.	41.	72.	60.
22	37.	21.	56.	26.	66.	24.	69.	34.	74.	54.	81.	48.
23	44.	25.	39.	15.	43.	23.	74.	51.	68.	55.	82.	50.
24	48.	32.	18.	8.	64.	33.	84.	52.	62.	50.	87.	56.
25	38.	27.	20.	7.	64.	33.	83.	49.	64.	49.	89.	61.
26	52.	29.	29.	10.	56.	31.	83.	54.	61.	36.	87.	66.
27	50.	24.	37.	29.	40.	25.	70.	49.	58.	49.	87.	68.
28	30.	20.	37.	24.	32.	21.	55.	46.	58.	50.	86.	63.
29	32	13.	......	......	51.	25.	55.	40.	64.	46.	85.	51.
30	49.	26.	......	......	60.	40	54.	35.	71.	46.	92.	56.
31	55.	37.	......	......	57.	40.	......	......	72.	53.	......	......
Averages	40.8	24.5	26.1	11.5	48.5	25.4	59.4	37.3	68.2	45.6	80.4	53.3

READING OF MAXIMUM AND MINIMUM THERMOMETERS FOR 1913 — (*Concluded*).

DATE.	JULY.		AUGUST.		SEPTEMBER.		OCTOBER.		NOVEMBER.		DECEMBER.	
	5 P. M. Max.	5 P. M. Min.	5 P. M. Max.	5 P. M. Min.	5 P. M. Max.	5 P. M. Min.	5 P. M. Max.	5 P. M. Min.	5 P. M. Max.	5 P. M. Min.	5 P. M. Max.	5 P. M. Min.
1	95.	70.	91.	64.	91.	50.	65.	53.	42.	27.	49.	39.
2	92.	66.	88.	52.	93.	52.	67.	56.	54.	32.	49.	39.
3	89.	59.	87.	59.	95.	63.	66.	54.	57.	34.	50.	38.
4	95.	64.	75.	61.	81.	57.	69.	50.	55.	38.	41.	35.
5	92.	68.	79.	49.	75.	59.	78.	44.	58.	35.	49.	40.
6	87.	65.	86.	55.	86.	56.	81.	52.	63.	30.	46.	35.
7	74.	51.	86.	61.	89.	62.	78.	50.	63.	41.	56.	34.
8	79.	57.	92.	59.	85.	65.	74.	56.	63.	41.	50.	23.
9	82.	58.	88.	61.	75.	45.	77.	59.	58.	43.	37.	20.
10	72.	58.	86.	59.	70.	35.	80.	57.	53.	29.	36.	26.
11	78.	52.	74.	46.	72.	38.	78.	59.	37.	28.	35.	15.
12	85.	50.	82.	49.	78.	49.	71.	46.	45.	30.	49.	9.
13	85.	51.	85.	58.	62.	43.	62.	42.	54.	40.	49.	36.
14	84.	53.	87.	55.	59.	32.	59.	37.	53.	39.	45.	34.
15	79.	55.	92.	57.	67.	28.	57.	40.	41.	32.	42.	23
16	83.	54.	96.	59.	73.	40.	60.	41.	39.	32.	41.	33.
17	82.	58.	98.	71.	71.	54.	64.	41.	51.	31.	51.	33.
18	86.	61.	96.	68.	65.	54.	61	44.	55.	30.	40.	26.
19	86.	58.	88.	59.	67.	47.	54.	37.	65.	47.	36.	15.
20	84.	58.	85.	46.	72.	47.	58.	41.	66.	53.	41.	22.
21	80.	56.	86.	56.	69.	54	44.	36.	69.	44.	43.	32.
22	86.	51.	82.	62.	61.	49.	53.	33.	73.	56.	38.	26.
23	88.	63.	68.	59.	60.	37.	59.	44.	67.	44.	39.	20.
24	79.	64.	79.	48.	69.	41.	57.	50.	49.	34.	38.	35.
25	79.	56.	69.	44.	82.	53.	57.	50.	46.	30.	37.	32.
26	83.	52.	83.	44.	80.	54.	47.	44.	48.	35.	35.	20.
27	91.	62.	82.	61.	65.	45.	59.	36.	37.	22.	22.	11.
28	92.	70.	78.	52.	71.	41.	59.	48.	40.	32.	29.	6.
29	92.	66.	81.	60.	77.	52.	52.	46.	43.	36.	29.	9.
30	90.	64.	76.	52.	72.	47.	47.	38.	43.	38.	34.	28.
31	92.	58.	79.	48.	......	......	38.	29.	......	......	38.	15.
Averages	85.2	59.	84.	55.9	74.4	48.3	62.3	45.6	52.9	36.1	41.1	26.1

READINGS OF THE STANDARD AIR THERMOMETER, 1913.

DATE.	January.			February.			March.			April.			May.			June.		
	7 A. M.	12 M.	5 P. M.	7 A. M.	12 M.	5 P. M.	7 A. M.	12 M.	5 P. M.	7 A. M.	12 M.	5 P. M.	7 A. M.	12 M.	5 P. M.	7 A. M.	12 M.	5 P. M.
1	33.	39.	34.	17.	17.	14.	30.	38.	32.	32.	53.	43.	53.	72.	74.	62.	77.	69.
2	36.	43.	43.	15.	21.	22.	25.	19.	16.	35.	47.	48.	66.	80.	80.	57.	62.	71.
3	37.	38.	33.	27.	29.	28.	13.	30.	32.	48.	51.	52.	64.	81.	84.	59.	76.	80.
4	28.	30.	26.	22.	23.	22.	21.	25.	25.	53.	71.	65.	64.	84.	82.	60.	68.	67.
5	21.	32.	28.	8.	17.	16.	20.	31.	29.	38.	40.	39.	67.	81.	82.	56.	68.	74.
6	38.	41.	43.	5.	11.	10.	30.	21.	11.	30.	32.	31.	66.	78.	65.	61.	75.	84.
7	28.	28.	26.	10.	19.	17.	2.	8.	9.	32.	37.	40.	47.	55.	59.	66.	58.	60.
8	26.	22.	18.	20.	19.	23.	6.	28.	30.	32.	45.	43.	46.	58.	62.	50.	53.	55.
9	13.	24.	23.	16.	22.	21.	38.	53.	48.	34.	43.	41.	43.	55.	52.	51.	58.	59.
10	23.	34.	34.	—7.	14.	11.	30.	37.	34.	34.	43.	39.	35.	42.	43.	53.	63.	70.
11	36.	40.	43.	26.	31.	31.	33.	37.	39.	45.	50.	51.	36.	47.	52.	61.	73.	76.
12	34.	26.	19.	12.	11.	7.	29.	45.	50.	44.	54.	50.	47.	61.	64.	62.	73.	79.
13	10.	24.	26.	7.	18.	21.	41.	50.	49.	42.	51.	48.	50.	64.	57.	62.	81.	81.
14	18.	30.	32.	15.	33.	36.	52.	64.	64.	43.	51.	50.	46.	54.	58.	68.	76.	76.
15	31.	41.	38.	30.	38.	41.	51.	65.	45.	40.	58.	59.	40.	41.	54.	68.	89.	88.
16	40.	40.	41.	18.	19.	16.	32.	27.	25.	46.	59.	58.	61.	65.	59.	75.	88.	88.
17	46.	55.	51.	20.	24.	18.	23.	26.	25.	41.	53.	55.	54.	66.	68.	63.	78.	76.
18	46.	44.	45.	14.	28.	24.	30.	50.	51.	43.	67.	72.	55.	68.	61.	61.	70.	72.
19	30.	31.	32.	25.	37.	43.	41.	58.	59.	41.	41.	40.	47.	56.	58.	60.	66.	70.
20	40.	46.	46.	40.	59.	57.	44.	61.	66.	29.	38.	41.	50.	62.	65.	64.	71.	72.
21	25.	26.	24.	32.	29.	28.	50.	66.	66.	35.	52.	56.	53.	54.	57.	61.	67.	71.
22	29.	35.	32.	32.	48.	39.	29.	32.	31.	43.	60.	69.	61.	69.	67.	59.	75.	77.
23	37.	37.	43.	24.	18.	15.	29.	41.	41.	58.	66.	72.	56.	58.	55.	66.	79.	80.
24	34.	39.	37.	10.	15.	13.	52.	58.	64.	60.	79.	79.	52.	55.	59.	69.	84.	83.
25	33.	38.	32.	9.	18.	17.	44.	35.	33.	55.	76.	82.	54.	59.	58.	72.	86.	70.
26	36.	48.	50.	15.	25.	29.	44.	56.	40.	60.	81.	70.	49.	53.	58.	73.	84.	84.
27	30.	28.	24.	34.	34.	29.	33.	32.	25.	51.	51.	49.	50.	52.	55.	70.	83.	85.
28	23.	28.	24.	25.	30.	29.	24.	30.	31.	50.	48.	55.	53.	53.	58.	65.	73.	76.
29	15.	27.	32.	......	......	......	31	46.	47.	41.	50.	53.	51.	59.	64.	67.	81.	81.
30	35.	43.	43.	......	......	......	43.	53.	57.	40.	51.	54.	54.	68.	66.	69.	87.	91.
31	40.	54.	37.	......	......	......	52.	55.	43.	......	......	......	59.	68.	71.	......	......	......
Averages	30.7	35.8	34.2	18.6	25.3	24.2	33.	41.2	39.3	42.5	53.3	53.5	52.6	61.9	62.8	63.	74.1	75.5

READINGS OF THE STANDARD AIR THERMOMETER — (*Concluded*).

DATE.	JULY.			AUGUST.			SEPTEMBER.			OCTOBER.			NOVEMBER.			DECEMBER.		
	7 A. M.	12 M.	5 P. M.	7 A. M.	12 M.	5 P. M.	7 A. M.	12 M.	5 P. M.	7 A. M.	12 M.	5 P. M.	7 A. M.	12 M.	5 P. M.	7 A. M.	12 M.	5 P. M.
1	87.	93.	93.	76.	87.	84.	64.	82.	85.	58.	61.	62.	33.	45.	43.	40.	44.	44.
2	70.	71.	79.	68.	86.	85.	65.	87.	90.	57.	66.	59.	38.	50.	48.	42.	46.	48.
3	70.	83.	86.	73.	87.	74.	69.	92.	81.	55.	62.	60.	40.	50.	52.	46.	43.	39.
4	79.	91.	91.	67.	72.	71.	62.	61.	61.	51.	63.	62.	40.	41.	39.	37.	40.	40.
5	70.	87.	87.	58.	76.	76.	59.	66.	71.	52.	72.	69.	36.	46.	48.	41.	43.	45.
6	71.	72.	65.	65.	83.	75.	62.	78.	83.	55.	76.	75.	33.	56.	54.	37.	41.	38.
7	58.	64.	74.	66.	81.	81.	71.	85.	85.	54.	74.	71.	42.	60.	56.	45.	52.	50.
8	64.	73.	76.	68.	88.	85.	71.	70.	75.	60.	75.	74.	50.	60.	56.	25.	28.	28.
9	65.	77.	73.	72.	76.	85.	51.	62.	60.	62.	75.	72.	45.	49.	53.	20.	36.	30.
10	62.	67.	68.	70.	78.	74.	46.	65.	64.	59.	76.	73.	32.	32.	30.	32.	35.	34.
11	65.	73.	73.	54.	70.	70.	45.	63.	69.	65.	74.	71.	29.	35.	33.	20.	18.	16.
12	63.	77.	78.	60.	77.	81.	58.	72.	62.	46.	60.	62.	31.	43.	43.	20.	45.	41.
13	73.	83.	84.	63.	78.	82.	55.	56.	56.	45.	53.	49.	48.	51.	53.	39.	45.	40.
14	61.	71.	75.	62.	82.	84.	48.	58.	56.	41.	57.	53.	45.	43.	39.	43.	48.	42.
15	63.	76.	77.	64.	85.	87.	41.	60.	65.	41.	57.	51.	34.	40.	38.	23.	40.	37.
16	65.	79.	81.	70.	88.	94.	50.	66.	71.	51.	54.	57.	34.	36.	36.	33.	40.	40.
17	63.	76.	73.	74.	93.	96.	57.	68.	62.	45.	62.	58.	33.	47.	45.	34.	46.	40.
18	67.	79.	83.	73.	91.	88.	55.	56.	55.	57.	60.	54.	31.	48.	51.	35.	32.	26.
19	67.	81.	84.	69.	78.	77.	52.	60.	65.	38.	50.	45.	49.	57.	63.	16.	32.	31.
20	68.	74.	66.	59.	81.	85.	58.	69.	69.	44.	56.	44.	60.	60.	53.	24.	38.	39.
21	64.	76.	78.	66.	81.	82.	64.	57.	54.	41.	41.	41.	47.	60.	63.	35.	41.	36.
22	67.	81.	85.	65.	65.	68.	50.	58.	53.	36.	48.	50.	57.	70.	66.	28.	32.	28.
23	71.	86.	79.	63.	63.	63.	44.	59.	57.	46.	57.	56.	60.	49.	45.	32.	36.	38.
24	66.	72.	78.	59.	75.	67.	47.	62.	65.	52.	57.	56.	39.	43.	36.	38.	37.	37.
25	60.	73.	75.	54.	67.	67.	56.	77.	77.	52.	53.	47.	32.	40.	40.	39.	35.	33.
26	65.	81.	82.	63.	78.	82.	60.	75.	63.	51.	35.	46.	42.	38.	36.	28.	25.	21.
27	70.	86.	90.	67.	76.	72.	50.	63.	59.	39.	56.	55.	23.	36.	35.	13.	19.	15.
28	72.	89.	91.	61.	74.	72.	47.	68.	67.	55.	55.	52.	34.	37.	40.	13.	28.	22.
29	76.	88.	87.	67.	77.	75.	55.	74.	67.	47.	50.	47.	37.	40.	40.	14.	24.	29.
30	76.	88.	86.	62.	69.	70.	49.	65.	61.	39.	40.	38.	40.	43.	42.	32.	33.	31.
31	74.	88.	91.	60.	77.	76.	......	......	......	30.	37.	34.	......	......	......	26.	35.	29.
Averages	68.1	79.2	80.3	65.1	78.7	78.3	55.4	67.8	66.9	49.2	58.8	56.2	39.8	46.8	45.9	30.6	36.7	34.4

SUMMARY OF MAXIMUM, MINIMUM AND STANDARD AIR THERMOMETERS FOR 1913.

	Maximum.	Minimum.	Standard.		
			7 A. M.	12 M.	5 P. M.
	Average.	Average.	Average.	Aberage.	Average.
January	40.8	24.5	30.7	35.8	34.2
February	26.1	11.5	18.6	25.3	24.2
March	48.5	25.4	33.	41.2	39.3
April	59.4	37.3	42.5	53.3	53.5
May	68.2	45.6	52.6	61.9	62.8
June	80.4	53.3	63.	74.1	75.5
July	85.2	59.	68.1	79.2	80.3
August	84.	55.9	65.1	78.7	78.3
September	74.4	48.3	55.4	67.8	66.9
October	62.3	45.6	59.2	58.8	56.2
November	52.9	36.1	39.8	46.8	45.9
December	41.1	26.1	30.6	36.7	34.4

MONTHLY MAXIMUM AND MINIMUM TEMPERATURE FROM 1883 TO 1913, INCLUSIVE.

(Highest and Lowest Record for each Month in Bold Face Type.)

	January.				February.				March.			
	Max.		Min.		Max.		Min.		Max.		Min.	
	Date.	Temp.	Date.	Temp.	Date.	Temp.	Date.	Temp.	Date.	Temp.	Date.	Temp.
1883	18.	44.	11.	—9.	17.	48.	24.	—2.	19.	61.	9.	2.
1884	3.	49.	26.	—13.	7.	55.	29.	—3.	30.	54.	1.	—4.
1885	1.	61.	29.	—6.	10.	38.	11.	11.5	28.	48.	13.	—11.
1886	5.	52.5	13.	—18.7	9.	50.	27.	—11.	16.	58.	2.	—2.5
1887	24.	50.7	19.	—8.	9.	54.2	27.	—4.	3.	51.7	1 & 5	8.7
1888	2.	43.2	23.	—6.	21.	49.	10.	—7.	28.	57.	13.	0.
1889	18.	55.	20.	5.	23.	42.	4 & 24	—7.	28.	61.8	30.	18.5
1890	6.	67.	29.	9.	5.	64.5	11 & 21	9.5	13.	62.	8.	2.
1891	3.	46.	17.	4.	26.	56.8	15.	2.5	12.	57.	2.	4.5
1892	3.	48.	10.	—5.	15.	44.	6.	2.8	27.	52.2	4.	6.
1893	29.	46.	11.	—6.	15.	47.4	5.	—1.	24.	54.	5.	9.
1894	5.	59.	13.	11.	20.	47.6	27.	—8.5	18.	73.	26.	15.
1895†	7.	45.	19.	4.	25.	46.	8.	—14.	25.	52.	5 & 16	12.
1896	30.	44.	6.	—16.5	29.	49.	17.	—21.	31.	56.5	24.	—2.
1897	5.	58.	20.	—3.5	18.	49.5	1 & 27	5.5	21.	64.	1.	—1.
1898	13.	57.	30 & 31	—4.	12.	56.5	2 & 3	—2.	11.	*65.	2.	17.5
1899	5.	59.	12.	—4.	21.	52.5	11.	—8.	13.	63.	21.	13.
1900	23.	56.	1.	2.	14.	57.	27.	0.	10.	46.	12.	—3.
1901	16.	48.	20.	—2.	16.	36.	24.	—2.5	24.	67.	6.	—1.
1902	3.	44.	28.	2.	28.	52.	6.	—3.	12.	66.5	19.	14.
1903	3.	48.	9.	—2.	28.	62.5	18.	—4.	19.	78.5	1 & 2	19.
1904	23.	48.	19.	—14.	7.	58.	16.	—18.	26.	58.	4.	8.
1905	1.	49.	26.	—2.	20.	45.	5 & 14	—6.	29.	82.	5.	1.
1906	21.	71.	9.	4.	24.	64.	6 & 7	—7.	27.	51.	25.	2.
1907	6.	53.	24.	—18.	2.	47.	12 & 18	—4.	29.	83.	7.	—1.
1908	22.	45.	31.	—9.	15.	53.	5.	—14.	28.	73.	1.	8.
1909	24.	64.	19.	—7.	5.	52.	1.	—1.	10.	52.	5.	5.
1910	2–22	45.	5.	—8.	16.	49.	7.	—3.	24.	82.	14 & 18	17.
1911	27 & 30	48.	5.	—1.	17.	52.	22.	4.	22.	62.	16.	—1.
1912	18.	44.	14.	—12.	24.	48.	10.	—10.	31.	62.	4.	—1.
1913	17.	57.	13.	8.	20.	65.	10.	—10.	14 & 15	69.	7 & 8	1.

* Maximum for first eleven days only. Record incomplete. † From data given by Mr. Edgar Parker. Station record not available.

MONTHLY MAXIMUM AND MINIMUM TEMPERATURE FROM 1883 TO 1913, INCLUSIVE — (*Continued*).

(Highest and Lowest Record for each Month in Bold Face Type.)

	April.				May.				June.			
	Max.		Min.		Max.		Min.		Max.		Min.	
	Date.	Temp.	Date.	Temp.	Date.	Temp.	Date.	Temp.	Date.	Temp.	Date.	Temp.
1883	16.	75.	1.	19.	11.	87.	1 & 14	31.	7.	86.5	2.	42.
1884	28.	74.	1.	23.	24.	88.	30.	32.	25.	90.5	15.	41.
1885	24.	84.5	10.	20.5	18.	81.7	3.	27.5	14.	86.5	23.	41.3
1886	24.	80.5	4.	22.	23.	79.5	17 & 18	37.2	14.	86.2	1.	42.2
1887	11.	75.7	1.	17.2	23.	88.2	14.	37.5	17.	89.2	15.	47.7
1888	29.	82.5	8.	19.	13.	79.8	3.	29.	23.	94.1	4.	40.
1889	20.	84.	1.	26.	18.	91.8	29.	32.	22.	85.	5.	46.
1890	13.	78.8	1 & 19	23.	4.	80.7	2.	30.	30.	85.6	8.	44.8
1891	28.	81.4	7.	21.	11.	85.5	4.	29.5	16.	95.	6.	40.
1892	6.	78.	17.	25.5	31.	78.	9.	34.2	14.	92.	11.	45.8
1893	13.	75.3	26.	25.	25.	88.	9.	35.	21.	94.	1.	44.
1894	21.	71.3	2.	20.	2.	85.4	14.	32.6	23.	91.6	6.	39.
1895*	30.	80.	3.	28.	31.	92.	13 & 21	36.	3.	96.	7.	54.
1896	17.	87.	4 & 5	19.	11.	87.5	7 & 20	40.	21.	89.	3.	41.
1897	26.	82.	20.	19.	24.	80.	8.	32.5	24 & 25	87.5	2.	42.
1898	14 & 18	69.	5.	18.	29.	79.	6.	34.	9.	90.	16.	40.
1899	30.	82.	3.	23.	2.	87.5	15.	32.5	6 & 24	93.	11.	41.5
1900	30.	†73.5	9.	†22.	15 & 16	88.5	7.	27.	25.	93.	10.	45.
1901	28.	78.	12.	28.	23.	78.	16.	36.	27, 28 & 29	95.5	2.	42.
1902	22.	87.	5.	25.	22.	90.	11.	26.	3.	85.	6.	38.
1903	30.	86.	5.	21.	19.	89.	2.	24.	30.	86.5	1.	39.
1904	24.	67.5	14.	16.	25.	88.	12.	31.5	5, 24 & 25	89.	12 & 17	45.
1905	27 & 28	75.	16.	23.	3.	82.	2.	29.5	19.	90.	1.	40.
1906	19.	74.	2.	25.	24.	88.5	11 & 21	30.	8.	92.	12.	37.
1907	29.	73.	2.	19.	14.	85.	2 & 11	28.	18.	94.	3.	41.
1908	27.	78.	4.	18.	29.	90.	1, 4 & 5	31.	19.	92.	12.	43.
1909	19.	75.	11.	12.	31.	78.	2 & 3	33.	28.	90.	8.	43.
1910	4.	84.	7.	27.	20.	79.	16.	31.5	22.	89.9	4.	36.
1911	29.	80.	3.	18.	22.	97.	4.	27.	11.	90.5	17.	46.
1912	6.	78.	4.	19.	24.	88.	14.	34.	1.	89.	8.	40.
1913	24.	84.	20.	24.	4.	91.	11.	30.	30.	92.	9.	37.

* From data given by Mr. Edgar Parker. Station record not available. † Thermometers broken. Record not taken from April 19 to 24, inclusive.

Monthly Maximum and Minimum Temperature from 1883 to 1913, Inclusive — (*Continued*).

(Highest and Lowest Record for each Month in Bold Face Type.)

	July.				August.				September.			
	Max.		Min.		Max.		Min.		Max.		Min.	
	Date.	Temp.	Date.	Temp.	Date.	Temp.	Date.	Temp.	Temp.	Date.	Temp.	Date.
1883	23.	86.	1.	46.	23.	92.	15.	46.	17.	80.	11.	37.
1884	2.	87.5	15.	50.5	20.	95.	25.	44.	5.	94.	14.	36.
1885	18.	90.5	12.	46.5	1.	89.	28.	45.	27.	83.7	24.	40.
1886	7.	95.	1.	45.2	30.	91.5	6.	47.7	11.	89.5	22.	40.
1887	3.	95.5	11.	58.7	3.	88.5	8.	46.	22.	81.7	27.	37.2
1888	5.	89.8	16.	47.	9.	92.6	23.	48.3	1 & 10	83.	7.	40.
1889	11.	90.7	6.	50.5	31.	86.7	16 & 17	50.3	4.	84.	22, 23 & 29	40.
1890	9.	94.5	24.	46.5	4.	96.2	24.	46.	8.	83.6	25.	35.5
1891	14.	92.	31.	46.	12.	92.	29.	46.5	26.	92.8	30.	43.
1892	29.	96.3	2.	46.4	10.	95.5	28.	49.	26.	88.	20.	39.
1893	26.	95.5	24.	48.4	11.	94.5	13.	39.	5.	80.	26.	37.4
1894	21.	97.	10.	49.6	25.	93.	27.	45.3	4.	90.	26.	33.
1895*	8.	94.	11.	52.	11.	88.	22.	44.	4.	94.	15 & 30	42.
1896	3.	94.	18.	49.	6 & 7	96.	29.	44.	12.	95.	23.	36.
1897	11.	97.	15.	57.	15.	87.5	21.	46.	11.	98.	21.	37.5
1898	4.	96.5	12.	40.	24.	90.5	28.	47.	4.	94.	21.	40.5
1899	4.	97.5	1.	50.	20.	97.5	15.	44.5	4.	92.	15 & 30	38.
1900	17.	96.	1.	50.	11.	97.	2.	51.	12.	95.	19.	37.
1901	1.	97.5	20.	54.5	22.	90.	5.	53.	6.	89.	26.	36.
1902	14 & 27	90.	1.	53.	31.	90.	13.	47.	1.	90.	15.	38.
1903	9.	94.	15.	50.	18.	85.5	8 & 14	45.	14.	90.	29.	35.
1904	19.	93.	3.	49.	25.	89.5	19.	45.	3.	88.	23.	33.
1905	18.	92.	22.	48.5	10.	93.	27.	41.	30.	88.5	26.	36.
1906	20, 22 & 23	89.	25.	50.	5.	93.	16.	47.	18.	91.5	25.	38.
1907	16.	90.	3 & 5	50.	12.	96.5	19.	41.5	20.	90.	27.	39.
1908	6, 11 & 30.	94.	9.	52.	4.	95.	25.	46.	10.	92.	30.	37.
1909	15.	92.	4.	42.	8.	98.	31.	32.	14.	93.	2 & 6	35.
1910	9.	96.5	5.	50.	3 & 15	90.	27.	44.	6.	87.	15 & 23	40.
1911	5.	105.	25, 26 & 27	50.	8.	94.5	30.	47.	2.	87.	14.	35.
1912	7, 8 & 10	95.	1.	41.	14.	92.	17.	44.	6 & 10	95.	30.	34.
1913	1 & 4	95.	12.	50.	17.	98.	25 & 26	44.	3.	95.	15.	28.

* From data given by Mr. Edgar Parker. Station record not available.

MONTHLY MAXIMUM AND MINIMUM TEMPERATURE FROM 1883 TO 1913, INCLUSIVE — (*Concluded*).

(Highest and Lowest Record for each Month in Bold Face Type.)

	October.				November.				December.			
	MAX.		MIN.		MAX.		MIN.		MAX.		MIN.	
	Date.	Temp.	Date.	Temp.	Date.	Temp.	Date.	Temp.	Date.	Temp.	Date.	Temp.
1883	11.	78.	17.	25.	22.	70.	17.	13.	10.	43.	23.	—7.5
1884	5.	84.2	27.	23.	11.	62.	25.	15.	31.	55.5	20.	—15.5
1885	1.	79.	31.	25.	8 & 13	68.	28.	18.	24.	53.	9.	4.
1886	10.	76.7	17.	27.5	3.	68.2	28.	17.	11 & 25	46.	6.	—6.
1887	9.	78.5	31.	21.2	28.	68.	30.	15.	12.	54.7	2.	—3.
1888	6.	62.7	22.	29.	1 & 3	73.	23.	8.	27.	53.	22.	4.
1889	2.	68.7	24.	21.2	4.	61.7	17.	17.8	25.	60.5	4 & 5	8.
1890	5.	69.8	31.	32.	8.	65.4	28.	17.	1.	46.2	20.	3.
1891	4.	89.4	12 & 25	27.	1.	68.	29.	12.	5.	57.7	18.	7.
1892	1.	82.	2.	33.1	19.	60	24.	18.	9.	49.2	27.	—3.7
1893	13.	76.	31.	25.	3.	62.2	27.	19.	26.	62.	14.	1.5
1894	1.	76.5	15.	33.	3.	65.	29.	12.	17.	59.	29.	—0.2
1895*	2.	72.	30.	28.	7.	68.	21.	19.	20 & 21	62.	13.	—2.
1896	30.	77.5	10 & 29	29.	19.	70.	21.	19.5	14.	58.	28.	2.
1897	16.	88.	10 & 18	30.	6.	65.	24.	16.5	12.	61.5	24.	2.
1898	1.	85.5	28.	31.	5.	63.	28.	16.	31.	54.	14.	3.
1899	15.	86.	3.	26.	19.	60.	14.	25.	12.	60.	31.	—1.
1900	6 & 7	89.	20.	28.	22.	70.	17.	19.	4.	55.	10 & 14	4.
1901	10 & 11	74.	28.	28.	1.	65.	27.	13.	14.	62.	18.	—1.
1902	19.	74.	10, 22 & 30	29.	14.	73.	29.	22.	2.	52.	9.	5.
1903	1.	73.	25 & 27	28.	4.	70.	26 & 27	12.	3.	46.	19.	—4.
1904	10.	81.	31.	22.	3.	65.	29.	9.	23.	53.	16.	—2.
1905	1.	85.	26.	20.5	12.	61.	14.	11.	29.	52.5	15.	1.
1906	5.	79.5	13 & 31	30.	19.	62.	30.	16.	6.	52.	8.	—1.
1907	7.	76.	31.	24.	1.	59.	16.	22.	30.	57.	22.	13.5
1908	18.	83.	21.	27.	26.	68.	5.	18.	1.	64.	23.	3.
1909	9.	82.5	29 & 30	27.	11.	75.	24.	21.	6.	45.	30.	1.
1910	6.	81.	30.	26.	1.	59.	23.	21.	29.	41.	31.	—2.5
1911	4.	78.	28.	26.	7.	43.	13.	18.	9.	·67.	4 & 30	13.
1912	6.	83.	16.	31.	6 & 7	69.	28.	20.	6.	65.	12.	12.
1913	6.	81.	31.	29.	22.	73.	27.	22.	7.	56.	28.	6.

* From data given by Mr. Edgar Parker. Station record not available.

YEARLY MAXIMUM AND MINIMUM TEMPERATURES FROM 1883 TO 1913, INCLUSIVE.

(Highest and Lowest Record in Bold Face Type.)

	Maximum for Each Year.		Minimum for Each Year.	
	Date.	Temp.	Date.	Temp.
1883	Aug. 23	92.	Jan. 11	—9.
1884	Aug. 20	95.	Dec. 20	—15.5
1885	July 18	90.5	Feb. 11	—11.5
1886	July 7	95.	Jan. 13	—18.7
1887	July 3	95.5	Jan. 19	—8.
1888	June 23	94.1	Feb. 10	—7.
1889	May 18	91.8	Feb. 4 and 24	—7.
1890	Aug. 4	96.2	March 8	2.
1891	June 16	95.	Feb. 15	2.5
1892	July 29	96.3	Jan. 10	—5.
1893	July 26	95.5	Jan. 11	—6.
1894	July 21	97.	Feb. 27	—8.5
1895*	June 3	96.	Feb. 8	—14.
1896	Aug. 6 and 7	96.	Feb. 17	**—21.**
1897	Sept. 11	98.	Jan. 20	—3.5
1898	July 4	96.5	Jan. 30 and 31	—4.
1899	July 4 and Aug. 2)	97.5	Feb 11	—8.
1900	Aug. 11	97.	Feb. 27	0.
1901	July 1	97.5	Feb. 24	2.5
1902	May 22, July 14 and 27, August 31 and Sept. 1	90.	Dec. 9	—5.
1903	July 9	94.	Feb. 18 and Dec. 19.	—4.
1904	July 19	93.	Feb. 16	—18
1905	Aug. 10	93.	Feb. 5 and 14	—6.
1906	Aug. 5	93.	Feb. 6 and 7	—7.
1907	Aug. 12	96.5	Jan. 24	—18.
1908	Aug. 4	95.	Feb. 5	—14.
1909	Aug. 8	98.	Jan. 19	—7.
1910	July 9	96.5	Jan. 5	—6.
1911	July 5	**105.**	Jan. 5	—1.
1912	July 7, 8 and 10 and Sept. 6 and 10	95.	Jan. 14	—12.
1913	Aug. 17	98	Feb. 10	—10.

* From data given by Mr. Edgar Parker. Station record not available.

AVERAGE MONTHLY AND YEARLY TEMPERATURE SINCE 1882.

YEAR.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly averages.
1883	17.4	22.3	23.6	43.3	50.	66.6	67.4	65.6	56.3	46.6	39.1	27.5	43.8
1884	17.6	28.3	29.5	40.7	54.3	67.1	66.5	69.9	65.2	50.5	36.5	27.2	46.1
1885	20.6	11.4	18.8	41.2	54.3	63.6	69.7	65.	58.3	49.2	39.3	27.8	43.3
1886	19.6	22.9	30.2	48.1	55.7	64.	68.	67.5	61.8	49.6	36.8	22.2	45.6
1887	20.2	23.2	26.3	41.1	62.5	65.7	75.6	66.5	57.7	47.	37.6	27.6	45.9
1888	16.4	22.8	24.6	40.8	54.3	66.5	66.8	68.	62.2	43.9	39.4	29.3	44.6
1889	29.1	18.1	33.9	45.1	58.4	65.3	70.2	66.	60.5	44.	40.3	35.2	47.2
1890	31.2	30.9	28.8	44.2	52.3	67.1	69.5	67.7	60.1	49.3	37.6	21.4	46.7
1891	25.9	28.3	30.8	45.3	52.	66.4	66.4	68.5	66.2	48.3	38.4	35.5	47.7
1892	21.4	25.9	26.5	43.5	52.8	68.6	70.2	69.4	61.3	50.	35.9	25.2	45.9
1893	15.5	20.6	29.5	41.1	54.1	68.2	69.8	68.8	58.	52.	38.2	27.5	45.3
1894	29.7	20.9	38.9	44.1	55.5	67.8	74.2	66.8	64.8	52.7	36.	31.5	48.6
1895	21.8	16.9	26.9	44.4	59.	......	......	71.2	61.7	45.4	39.6	31.4	....
1896	22.4	24.1	24.4	49.3	62.	65.9	71.4	70.	60.2	56.5	42.9	27.1	48.
1897	23.2	26.1	33.8	45.	55.4	62.3	73.6	67.6	62.3	52.6	39.7	29.2	47.6
1898	26.2	26.8	......	43.2	57.	67.7	74.2	71.	65.9	52.1	37.9	27.9	....
1899	22.1	20.4	30.4	46.6	57.6	69.5	71.2	71.6	60.6	53.4	38.9	30.	47.7
1900	26.	22.6	23.6	43.5	56.7	68.4	72.6	74.1	66.1	57.9	41.1	28.7	48.5
1901	26.1	18.5	32.2	46.5	56.9	68.9	76.6	71.	64.	51.4	34.3	27.7	47.9
1902	23.2	22.2	39.5	46.6	56.1	63.2	71.2	67.6	63.6	43.1	46.3	25.7	47.4
1903	25.7	28.1	42.4	45.9	60.4	63.2	70.8	65.5	64.4	52.5	36.2	23.3	48.2
1904	18.9	23.1	30.9	41.4	60.3	67.8	70.	68.2	61.9	48.4	36.9	22.5	45.9
1905	19.8	18.9	33.1	44.8	57.5	66.4	71.8	68.7	63.7	52.4	37.6	32.	47.3
1906	32.5	26.1	27.6	46.4	57.5	68.2	71.4	72.8	67.3	51.2	37.9	26.1	48.8
1907	24.9	19.5	38.1	40.2	51.3	64.	71.2	68.4	64.4	47.9	38.7	31.8	46.7
1908	25.9	21.3	34.6	44.8	59.2	68.8	73.4	68.8	67.	52.9	40.	29.2	48.8
1909	27.7	28.6	31.	44.3	57.9	67.2	69.6	70.	63.5	47.7	44.5	25.7	48.1
1910	25.1	22.1	42.1	50.1	54.9	65.2	73.1	69.	63.2	53.1	35.7	21.5	47.9
1911	27.9	26.6	30.9	44.8	64.9	67.5	74.4	70.9	62.8	50.7	36.6	35.1	49.4
1912	15.9	21.6	28.2	45.1	58.9	64.3	73.2	68.6	68.4	53.5	42.5	33.9	47.8
1913	32.7	18.8	36.9	48.3	56.9	66.8	72.1	70.	61.3	54.	44.5	33.6	49.7
Monthly averages	23.6	22.8	30.9	44.5	56.7	66.4	71.2	68.9	62.7	50.3	38.9	28.4	47.1

PRECIPITATION BY RAINFALL ONLY BY MONTHS SINCE 1882.

YEARS.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Total.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
1882	......	......	......	......	......	3.69	2.42	2.37	1.25	0.62	1.22	0.55	......
1883	0.48	1.44	0.88	1.58	4.45	4.12	2.98	3.47	2.12	2.10	1.54	0.73	25.89
1884	1.83	2.01	2.54	0.83	2.49	2.01	2.33	1.44	3.17	1.67	1.01	0.97	22.30
1885	1.07	0.61	0.12	1.26	1.58	2.49	4.64	5.02	2.11	2.88	1.36	0.76	23.90
1886	1.13	0.95	1.13	4.13	1.92	2.92	4.41	2.86	2.31	1.39	3.48	1.24	27.87
1887	0.18	2.17	0.48	1.37	0.46	2.01	6.37	3.03	0.75	1.74	1.58	1.35	21.49
1888	0.78	1.04	1.43	3.09	2.79	3.88	0.99	4.02	2.73	3.47	2.02	1.24	27.48
1889	2.99	0.25	0.66	3.28	1.21	7.47	4.57	4.98	2.50	3.32	3.44	1.62	36.29
1890	2.16	1.45	2.16	2.20	5.49	5.26	1.07	4.34	5.81	4.54	2.40	......	......
1891	1.44	1.57	3.25	1.63	0.49	4.31	3.52	3.16	0.47	3.65	0.74	3.29	27.52
1892	0.57	0.88	0.55	0.67	4.04	3.95	1.89	4.77	1.12	1.34	2.67	0.72	23.17
1893	1.62	3.71	1.94	2.59	4.92	3.08	3.68	5.38	2.68	1.59	1.09	1.56	33.84
1894	2.21	2.71	1.36	2.43	7.03	1.77	1.50	1.22	4.64	3.59	0.43	0.47	29.36
1895	0.96	......	0.29	1.33	2.88	......	......	2.66	0.94	0.72	2.31	2.49	......
1896	1.19	2.28	0.84	0.41	2.31	3.71	4.12	3.33	4.27	2.26	2.18	0.71	27.61
1897	0.64	0.21	2.12	1.90	2.19	3.16	5.28	1.27	2.36	0.73	2.53	1.39	23.78
1898	1.74	0.83	1.54	2.03	1.90	2.39	1.32	3 60	1.86	3.83	2.03	0.33	23.40
1899	0.37	0.30	1.22	1.12	1.69	1.71	4.15	1.05	2.23	2.69	1.36	1.46	19.35
1900	1.43	2.42	0.02	0.95	1.71	1.45	6.53	1.75	0.91	3.65	6.13	0.78	27.73
1901	0.72	......	2.19	4.43	3.80	2.07	3.97	5.62	2.46	1.35	2.09	3.37	......
1902	0.86	0.66	1.94	1.92	2.84	4.33	5.25	2.41	2.88	2.32	0.74	0.74	26.89
1903	1.81	1.11	5.60	2.60	0.23	7.77	4.86	7.21	1.30	4.19	1.63	0.38	38.69
1804	0.80	1.03	2.41	1.67	4.04	3.37	5.73	2.56	3.26	2.06	0.26	1.42	28.61
1905	0.40	0.27	1.09	2.05	2.01	8.78	3.39	5.44	1.90	3.69	1.32	1.84	32.38
1906	1.46	0.53	1.60	2.08	2.24	5.31	2.37	3.68	2.16	3.56	1.40	1.54	29.93
1907	1.89	0.03	1.14	2.42	1.82	2.34	2.86	1.35	2.73	3.48	2.78	1.89	24.73
1908	0.68	1.24	1.12	3.28	3.57	1.96	4.72	1.79	1.66	2.73	0.88	0.43	24.06
1909	0.94	1.68	1.35	3.20	2.83	2.17	2.04	2.21	2.22	1.18	0.56	0.49	20.87
1910	0.87	0.53	0.28	4.56	3.45	1.55	2.39	5.47	3.29	1.73	0.62	0.38	25.12
1911	0.91	0.24	1.07	3.24	1.36	2.51	4.49	3.36	3.21	2.37	1.41	2.08	26.25
1912	0.20	0.95	1.92	3.41	7.27	2.09	4.85	2.21	5.89	1.42	1.48	1.13	32.82
1913	3.88	0.11	4.64	3.40	2.68	3.24	2.03	1.65	2.64	4.03	2.41	0.77	31.48
Monthly and yearly averages	1.23	1.15	1.58	2.29	2.89	3.45	3.38	3.27	2.49	2.50	1.78	1.23	27.25

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